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ARMED FORCES CHEMICAL JOURNAL

ARMED FORCES CHEMICAL ASSOCIATION

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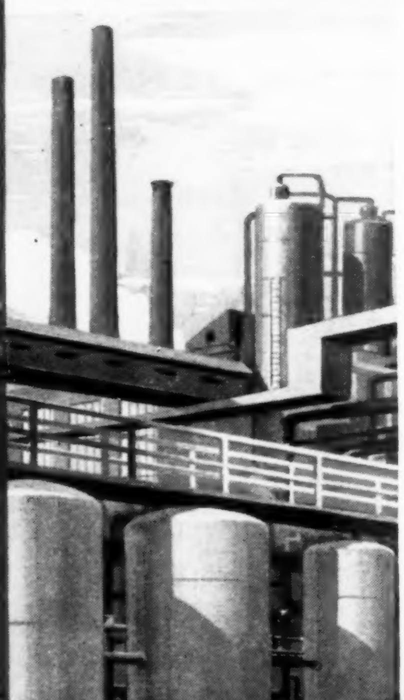
1950



ARMED FORCES CHEMICAL JOURNAL

OFFICIAL PUBLICATION OF THE ARMED FORCES CHEMICAL ASSOCIATION
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The Armed Forces Chemical Journal is the official publication of the Armed Forces Chemical Association. The fact that an article appears in its columns does not indicate the approval of the views expressed in it by any group or any individual other than the author. It is our policy to print articles on subjects of interest in order to stimulate thought and promote discussion; this regardless of the fact that some or all of the opinions advanced may be at variance with those held by the Armed Forces Chemical Association, National Officers, and the Editors.

COVER PHOTO

Maj. Gen. Anthony C. McAuliffe, Chief, Chemical Corps, accepts a Life Membership card in the Armed Forces Chemical Association from Col. Harry A. Kuhn, AFCA's President. The presentation was made at a dinner in honor of General McAuliffe sponsored by the Directors of the Association.

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NEWS OF THE SERVICES

AFCA Chemical ORC Units

In recognition of those Chemical Reserve Units boasting of 100% membership in the Armed Forces Chemical Association, the *Journal* and *News* will feature a listing of such units under the AFCA HONOR ROLL. Meanwhile, commanding officers of Reserve units are urged to solicit association memberships within their respective organizations forwarding the names of new members to National Headquarters. Commanding officers of 100% AFCA units are urged to submit their organization for appropriate recognition in the Association's publications.

* * *

B-36 vs. Banshee

Under direction of the Weapons System Evaluation Group, special electronic devices are being used at Aberdeen Proving Ground, Md., to compute data concerning the B-36 and the Navy's twin-jet fighter plane, the Banshee. For the present, the tests are being restricted to mechanical computations of probable results if the two planes were to meet in aerial combat. It may be necessary eventually to have the two planes actually engage in aerial maneuvers, but a plan for such a contest was called off at the request of the Joint Chiefs of Staff. At Aberdeen, statistical data concerning the performance of the Air Force bomber and the Navy fighter are "fed" into the machine, which comes up with the answers. The results of these calculations may have an effect on aircraft purchases this year.

* * *

"Legislative Reactions"

The Defense Department informs Congress it is opposed to certain bills providing special recognition for Reserves. Two bills, sponsored by Senator Smith, (R. Me.) and Rep. Javits (D. N.Y.) would create an "Army Reserve Medal" for officer and enlisted reservists who complete 10 years active or inactive honorable service in the Reserve. Another bill, sponsored by Senator Smith, would create an "Army Reserve Special Commendation Ribbon" for officers of 10 years service who meritoriously commanded an organized unit of the Reserve for four years before the war. Defense Department objections to these bills centers on the point of distinguishing between Regular and Reserve by items of uniform.

* * *

Strength Reductions

The second phase of the reduction in strength of Army Reserve officer personnel will affect approximately 2,800 officers who will be released from active duty not later than March 31, 1950. These officers were notified during December and will receive notice at least 90 days prior to separation.

* * *

Agents' Award

The Defense Department does not like Rep. L. Gary Clemente's proposal for a Medal for Valor to go to persons who performed outstandingly in undercover activities. Reporting on the New York Democrats' bill, the department through Chairman Thomas R. Reid of the Personnel Policy Board said other decorations were available for such agents. To give them a special decoration "would definitely publicize by name individuals engaged in secret or undercover activities" and would embarrass the United States by focusing attention on such activities.

* * *

RA Commissions

The Army directive which authorized the appointments of second lieutenants in the Regular Army of individuals having one year of commissioned wartime service and possessing a degree from an accredited college has expired. However, because numerous applications for appointment have been received from men who have not completed the required schooling, the Army has extended this program until October 1, 1950.

* * *

Army Regulations

The Superintendent of Documents, Government Printing Office, has announced that Army Special Regulations will no longer be stocked for sale to the public. AFCA members, however, will be presented pertinent regulations thru the Journal and News Letter.

* * *

Airborne Problems

The D/A, placing increasing emphasis upon airborne, air-transportability and air-ground support techniques, is faced with the necessity of lighter equipment or larger planes to insure the success of paratroop and other air assaults. According to airborne experts, firepower and protection of paratroopers must be increased. With regard to the problem of lighter equipment or heavier planes, the technique of dropping light artillery has been developed to the point where 105's have gone into action 12 minutes after hitting the ground. Meanwhile, because of the heavy protection needed for tanks, and because of the delicate mechanisms of antiaircraft materiel, it appears in the eyes of airborne experts that the solution to these problems may consist of providing planes that can carry the equipment, rather than by reducing the weight of the equipment.

* * *

Hourly Pay

To assist finance and fiscal officers in cost accounting procedures, D/A has revealed the average hourly military pay and cash allowances under the Career Compensation Act. Rates are:

Grade	Basic Pay
Lt. Gen.	6.01
Maj. Gen.	5.77
Brig. Gen.	5.07
Col.	4.41
Lt. Col.	3.43
Maj.	3.10
Capt.	2.69
1st Lt.	2.32
2nd Lt.	2.03
M/Sgt.	1.57
Sgt. FC	1.31
Sgt.	1.14
Cpl.	.97
Pvt. FC	.83
Pvt.	.69
Recruit	.65

Temporary Promotions

Although details are not yet available, it is known that the Air Force is giving consideration to plans for making temporary promotions during the early part of 1950. When boards will be convened and the approximate number of officers to be promoted are facts which have not been determined finally at USAF Headquarters. Presumably, however, because of budget restrictions there will be fewer promotions this year than last.

* * *

USAF Geophysicists

The Air Force Institute of Technology at Wright-Patterson Air Force Base, Dayton, Ohio, is instituting a program which will send a selected group of officers to civilian colleges and universities for education at the Master's degree level in the science of geophysics. This is in line with the USAF's need for geophysicists for assignment in the Air Force office of Atomic Energy. Applicants are restricted to regular Air Force officers with at least one year of commissioned service and be under 37 years of age. Also, a bachelor's degree in the physical sciences or in engineering is prerequisite.

* * *

Survival Food Packets

Two survival food packets have been developed by the Quartermaster Corps for testing purposes. One packet is intended for Arctic use and the other for air crews forced down in tropical areas. Tests to be conducted on the Arctic packet are scheduled for this winter in order to evaluate performance under field conditions.

* * *

MD Mobilization

The Armed Forces count in their reserves today about 26,000 doctors, 11,000 in the Army Reserves and 15,000 in the Naval Reserve. Of a total 197,000 doctors in the United States, a complete and immediate mobilization would mean a diversion of 13% of the Nation's medical talent from normal pursuits. Accordingly, mobilization officers are concerned with the production of a balanced program, phased with the requirements of the civilian population.

* * *

Retirement Changes

With the return of Congress this month several recommendations of the Hook Commission on Service Pay which were not embraced in the Career Compensation Act passed at the first session will be on the docket for consideration by the Armed Services Committees. These will include voluntary and involuntary retirement features and survivor benefits. The provisions will be covered by a new measure and not by provision of the Pay Act. There is considerable support for the view that those retired as a result of disabilities greater than 30 percent, due to wounds in action or otherwise directly attributable to active military service, should receive the full 75 percent of active duty pay, irrespective of length of service, instead of having their compensation based on degree of disability as at present. The suggestion has been made that if the retired compensation in such cases is inadequate the Veterans' Administration should liberalize its standards, in order that retired personnel may qualify for higher rates.

* * *

CC Research Council

The Army Chemical Corps Research Council meeting in December at the National Academy of Sciences in Washington had the opportunity to meet the new chief, Maj. Gen. Anthony McAuliffe. The council maintains co-ordination among military and civilian scientists in the chemical field and provides advice on the corps' research and development programs. Dr. H. F. Johnstone of the University of Illinois is chairman.

* * *

Enlistments Tightened

It's getting harder and harder to get into the armed services. While all the services have drastically reduced the number of new men they will accept this month, the Air Force also has raised the intelligence score it requires of new recruits from 90 to 100 and changed the minimum enlistment period from three to four years.

* * *

Chlorine Institute

Maj. Gen. Anthony C. McAuliffe, Chief of the Chemical Corps, will speak at the annual meeting of the Chlorine Institute on January 25, 1950, at the Biltmore Hotel, New York City.

* * *

Navy Reserve Promotions

The Navy is tightening requirements for reserve officer promotions. An announcement says reservists selected for promotion after January 1 of this year must complete required correspondence courses covering basic and specialized subjects, either before selection or within a reasonable period following notification of selection. Under the new system, promotion units will be earned by taking the correspondence courses. Basic courses, to be required of all officers, will include such subjects as Navy regulations, naval orientation and naval command and administration. About 100 specialist courses will cover different officer classifications and specialists.

* * *

Active Duty Tours

Qualified Chemical Corps Reserve officers are needed for 60 and 90 day tours of active duty to help in preparing extension courses, field manuals, and related publications for the Chemical Corps School at Army Chemical Center. These tours provide (1) active duty pay; (2) credits for retirement; (3) credits for retention in the active reserve. Application forms (D/A AGO Form 1058) are available at any Army installation.

* * *

Army Cutback

Relief from active duty by March 31 faces as many as 713 more Reserve officers than had originally been scheduled to go. About 1300 Reserves received 90-day separation notices, on the recommendations of army area commanders calling for release by December 31 at the latest.

Now, the augmented Army Personnel Board is driving ahead to recommended separation by March of 2800 more Reserve officers. The original estimate for this second stage of attrition was 2137, not 2800.

* * *

To Reveal Pass-Overs

Officials in the Army who had opposed publication of Regular officer pass-overs have agreed that the withheld information should be made public after all—as it had been in the past. Army selection boards in the future, it was decided, "will disclose their findings without fear, that all may criticize if they will, but that no one can accuse the department of trying to cover up anything." High public information officials had feared that this reaction would develop in the field if board data were not disclosed.

* * *

A-Bomb Effects

According to Col. Thomas F. McCarthy, lecturer with the Industrial College of the Armed Forces, the man in a well-built, underground shelter is relatively secure if an atomic bomb should fall directly above him. He adds that any one more than 2 miles from the spot where the bomb falls has more than a fighting chance to survive the worse effects of flash burns and radiation. However, the colonel advises that the nation should be prepared—through adequate civil defense—just in case a bomb is tossed.

DU PONT IN WORLD WAR II

THE FAMED BOEING B-29 "SUPERFORTRESS" OF WORLD WAR II
Its building required as many as 86 chemical products from one company plant.

IN AUGUST, 1939, ONE MONTH BEFORE HITLER INVADED POLAND, DU PONT HAD ONLY ONE SMALL SMOKELESS POWDER PLANT AND ONE TNT PLANT IN OPERATION AND THAT TNT PLANT WAS THE ONLY ONE OPERATING IN THE UNITED STATES—SO THIN HAD BECOME INTEREST IN NATIONAL DEFENSE!

By
Lt. Col. William S. Dutton*

It wasn't so many years ago, when the pacifists were in full cry, that Big Business and the International Bankers were blamed for all wars.

Hitler & Company exploded that one.

But throughout the army in World War II, and doubtlessly in other services as well, the idea continued to persist that the boys of the home front, especially those in business spelled with the big B, were getting fat helpings out of the billions from the Washington trough—in short, that war was still a lucrative pastime to those who reaped the war contracts.

I recall a staff meeting at Third Army Headquarters one winter day in 1944 when everything we had was hung up against the Siegfried Line, one large reason being insufficient ammunition.

"Why aren't we getting the stuff?" somebody asked.

The briefing officer, from the deep South, replied in his best drawl that he reckoned the munitions makers were holding up Uncle Sam for more profits.

My protest was lost in loud laughter when the officer with the drawl added, "I thought that would get a rise out the Major from Du Pont."

Since that time much water has flowed under the holds of Victory ships, including that one which several years ago returned me to civilian life, but again I rise to set the record straight. There is abundant evidence that the biggest producers of war goods got the smallest share of the war dollar, as figured on the size of the job done.

This was not accidental.

First of all, the forward-looking big business with its future at heart could not afford to profiteer at the risk of losing the public's good will. Second, it could not profiteer even if willing to take the chance with its future. Excess profits taxes, contract renegotiation procedures and other official checks took care of that.

Third, checks or no checks, the average big businessman did not want to line his pockets at the expense of his country. He wanted the record to be good, just as good as he could make it.

And, generally, the record is *good.*

"One major lesson — indeed, the major lesson—of this war is plain;" wrote Hanson W. Baldwin, military analyst of the *New York Times* in his paper on June 15, 1945. "It should be stated and restated, emphasized and re-emphasized, so that Americans never will forget. The war against Germany was won, the war against Japan is being won, because of the superiority of the industry of the United States. The industrial strength of America has been the dominating and decisive factor in this war."

Nobody in the Army or Navy, to my knowledge, is in dispute with this fact after four years of delivering industry's output to the enemy in every part of the world.

Perhaps the business man's desire for a good record was selfish—most human desires are—but it is susceptible to other interpretations too. Maybe he had a son at the front, for the draft was no respecter of individuals. Being an American, maybe his sense of patriotic duty was just as keen as any other good American's. Or maybe

*Colonel Dutton is the author of "DU PONT—140 YEARS" published by Scribner's in 1942. During World War I, he served with the infantry of the 42nd Division; in World War II, he served as a General Staff officer with Generals Patton and Bradley. He has had 36 months combat service in two wars, which credit him with ten bronze battle stars.

he believed what his advertising writers said about the responsibility of all business to the nation that nurtured it, and to the public that bought its goods. Soon that public was to have a stake in every far-flung battle zone. Human stakes!

The Business View

I began the war with the Du Pont Company, not entering the army until 1943. Du Pont's is a good example of the busines viewpoint toward the war, a viewpoint which I watched develop at first-hand.

Du Pont help was sought early and widely. Not only was the bulk of the military explosives program charged to the company, on a scale rising as swiftly as a cyclone, but soon Du Pont plants were asked to supply a thousand kinds of chemicals for a hundred industrial fronts, chemicals that ranged from synthetic rubber to DDT powder, from nylon to the key element in atomic bombs. The sums to be expended, the quantities of materials involved, the hazards that were to be taken to achieve maximum outputs in a matter of months, added up to Buck Rogers stuff.

Grimly determined Du Pont executives accepted the orders from Washington—those for new war plants alone were eventually to aggregate $1,034,000,000—but there was no joy in Wilmington, Del., Du Pont headquarters since 1802. The company had been through five other U. S. wars and their inevitable aftermaths of recrimination and investigation. Memories of the Senate Investigation of the Munitions Industry, in 1934, were still fresh. Propaganda which had almost wrecked military preparedness still echoed in the halls of Congress.

In August, 1939, one month before Hitler invaded Poland, Du Pont had only one small smokeless powder plant and one TNT plant in operation, and that TNT plant was the only one operating in the United States. All told, not more than 400 workers were employed by the company in military explosives manufacture, keeping alive the art at the insistence of the War Department. So thin had become interest in national defense.

But there are traditions in Du Pont that date to the nation's youth, and one of them is that the company's place in war is at the side of its government. Over the next three-year period, Du Pont expanded its force of 400 military explosives workers to 37,000. It expanded its engineering forces from slightly more than 5,000 men to almost 55,000 in 1942.

The Du Pont share alone of the war explosives program entailed the production of greater quantities of explosives than had been fired in all of America's earlier wars combined. Starting practically from scratch, the company actually attained an output in excess of the projected demand. It exceeded by 20% the entire volume of explosives used by all of the Allies in World War I.

The totals are staggering: 2,500,000,000 pounds of smokeless powder 1,500,000,000 pounds of TNT, 110,000,000 pounds of tetryl, and nearly 200,000,000 pounds of RDX compositions of a wholly new sort.

Smokeless powder lines first rated at 100,000 pounds per day actually produced 167,000 pounds and more per day. The TNT lines rated at 33,000 pounds daily were exceeding 100,000 pounds daily when the war ended. The combined savings on new construction made unnecessary by these results were estimated at $257,700,000, all money that could be diverted to other war needs.

Meanwhile, manufacturing costs in the government's great explosives plants built and operated by Du Pont declined steadily. The figures speak for themselves:

Product	Cost Decline
Cannon powder	27.4%
Rifle powder	35.5%
TNT	47.9%
DNT	57.2%
Tetryl	56.7%
TNT blocks	35.8%
RDX	39.8%

"Some of this decline was due to 'free issue' by the Government of certain materials and supplies," reports Du Pont's president. "In general, however, lower costs were due to greater efficiency and improved process, with, of course, increasing production volume."

The making of war explosives constituted less than 25% of the overall job performed by Du Pont during the war. And quoting a Du Pont report of stockholders:

"A mechanized war machine demand rayon and nylon tire cord, synthetic rubber to replace the loss of the natural product, petroleum additives for gasoline and fuel oil, and heavy chemicals by the thousands of tons to supply the industries producing combat equipment.

"Air power called for hundreds of special chemical materials — plastic enclosures, finishes, ingredients for high-octane gasoline, tire yarn, synthetic rubber and high-tenacity rayon for self-sealing gas tanks. Nylon replaced silk for parachutes. As many as eighty-six chemical products from one company plant alone went into the building of a superfortress.

"To a nation at home working to supply and feed its armies and its allies went commercial explosives to mine coal and metals, rayon for clothing and other textile necessities, finishes to protect property, and such other chemical products as could be spared to support the domestic front. Fertilizers, fungicides, vitamins, and insecticides helped swell agricultural production; refrigerants, mold-inhibitors, and special packaging materials safeguarded perishable foods.

"The determination of the country to do everything possible for the health, comfort, safety and protection of combat personnel necessitated the use of a great variety of materials. These included 'Freon' flourinated hydrocarbons for refrigeration and aerosol anti-malerial units; nylon for netting, hammocks and special apparel; gas-proofing and decontamination materials; neoprene for life rafts and protective clothing; strontium nitrate for signal flares; water-purification chemicals; flame-proofing and water-proofing compounds; and new insecticides such as DDT, which the company was among the first in this country to manufacture.

"To the services' medical corps went X-ray film, peroxides, disinfectants and germicides, plasma filters, plastics for prosthetic and orthopedic surgery, nylon surgical sutures, and the ingredients of sulpha drugs."

It is a bewildering list, but still doesn't cover the entire Du Pont job. The company's largest single undertaking during World War II, and perhaps its most spectacular and least publicized was its part in the atomic energy project.

Du Pont's report sums up that work thus:

"The specific responsibilities assumed by Du Pont were to design and construct a small-scale pilot plant at the Clinton Engineer Works in Tennessee, and to design, build and operate a large-scale plant known as the Hanford Engineer Works near Pasco, Washington.

"The work represented a complete departure from the field of chemical manufacture. More significantly, it dealt with an entirely new force. Du Pont was, in fact, called upon to take the data which the nuclear physicists were collecting in their exploration of an unknown world, and translate them into terms of a finished tangible product.

"This product was a man-made atomic energy element known as plutonium, which had been discovered in 1941, and had been made only in microscopic laboratory quantities. At the start, less than a milligram of

(Continued on page 38)

THE CHEMICAL DIVISION
EUROPEAN COMMAND

JUST FOR THE RECORD—"THE CHEMICAL DIVISION, EUROPEAN COMMAND, IS FULLY PREPARED TO AGAIN ASSUME AN IMPORTANT HIGHLY TECHNICAL ROLE AS A PART OF THE U. S. ARMY IN EUROPE IF AND WHEN WAR COMES."

By
Col. Charles E. Loucks*

The Chemical Division, European Command, is the lineal descendent of the original Chemical Section, Headquarters, Service of Supply, European Theatre of Operations. The section was activated in London, England, on 10 June 1942. For sake of completeness it should be noted that for a few weeks before that date, the office of Chemical Officer, European Theatre of Operations, was in existence in London, but phased out simultaneously with the organization of the section. Within a month or six weeks after activation, the section, as a part of the Service of Supply, moved with it to Cheltenham. Various changes in organization and name occurred during its training period, following which the Chemical Section accompanied the invasion forces to the continent. There it was stationed in various places, including Paris and Frankfurt and is now located in Heidelberg, Germany, as a part of and at the Headquarters of the European Command. At present the Chief of the Chemical Division, European Command, is also Chief Chemical Division, United States Army, Europe, in command of assigned Chemical troops.

From the hour of landing on Omaha Beach, Chemical Corps units played an important role in the defeat of the German armies. The 4.2" Chemical Mortar Battalions were manned by Chemical Corps troops. This mortar proved to be one of the outstanding weapons of the war and the Mortar Battalions contributed greatly to the success of the allied troops in Europe. As a result of the demonstration powerful effects of its HE filled and WP filled shells against enemy personnel, its great mobility, simplicity and cheapness, this mortar has since been made the standard heavy mortar of the Infantry Division.

The Smoke Generator Companies produced protective blankets of smoke over our men which could not be penetrated by enemy observers. They saved many lives and made possible river crossings and bridge building operations in the face of the enemy.

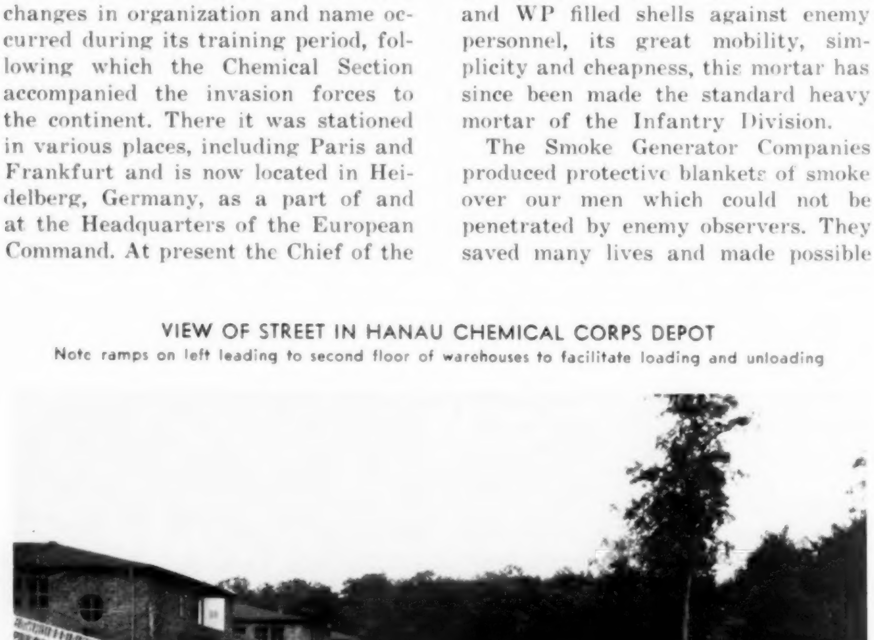
The Chemical Corps thru the division supplied many items to the non-chemical ground troops in Europe. They included gas masks and the numerous other items of protective equipment and materials in addition to flame throwers and several kinds of grenades and smoke pots.

The Chemical Division supplied the Air Forces in the European Theater all during the war with flame, smoke and incendiary bombs as well as with a large stock of toxic chemical filled bombs and bulk chemicals which were not used but were held for instant retaliatory purposes. The knowledge of the presence of this materiel and willingness on the part of the United States to use it in retaliation, may have been the one deterrant that prevented a chemical war.

Appropriate functions of the chemical Division, European Command, and United States Army, Europe, include among others:

a. Command of EUCOM Chemical Corps Technical Service installations and assigned units.
b. Supervision of units (technical scientific intelligence teams when organized) for collection of enemy materiel of types for which the Chemical Corps is responsible, for evaluation of its effectiveness, and determination of the technique of use and maintenance.
c. Collection of intelligence on enemy chemical, biological and radiological plans, training and materiel.
d. Implementation of policies and plans pertaining to:
   (1) Defensive measures incident to chemical, biological and radiological safety.
   (2) Requirements for allocation and assignment of troop units and technical specialists.
   (3) Requirements, procurement, use, stock control, storage, issue, allocation, salvage, disposition, budgeting and cost ac-

VIEW OF STREET IN HANAU CHEMICAL CORPS DEPOT
Note ramps on left leading to second floor of warehouses to facilitate loading and unloading



*Colonel Loucks, a regular contributor to the JOURNAL, is Chief, Chemical Division, Headquarters, European Command.

U. S. Army Photo

AT HANAU CHEMICAL CORPS DEPOT . . .
. . . collecting and removing live German ammunition.

counting incident to supplies, materiels and equipment.

(4) Technical supervision over the demilitarization of captured toxic enemy materiel.

(5) Technical training of personnel.

(6) Methods, techniques and materials for decontamination of areas, equipment, materiel and personnel contaminated by chemical, biological and radiological agents.

The Chemical Division, like other staff divisions, suffered great reductions in personnel immediately subsequent to the cessation of hostilities and later during reduction in the size of the occupation forces.

At one time there were hundreds of officers and thousands of enlisted men of the Chemical Corps in the European Command. The strength of the Office, Chief, Chemical Division, reached an all time low in 1948. Incident to increased responsibilities and greater activities in recent months this office has been somewhat expanded. Currently the division still has a very small authorized personnel strength, being one of the smallest in the European Command.

Beginning with the organization in England, British civilian employees were a major factor in the operation of the office. In time their number dwindled until the last remaining one resigned in August of this year in order to migrate to the United States.

After the cessation of hostilities in Europe, Chemical Mortar Battalions, Smoke Generator Companies and other Chemical Corps units were gradually redeployed, inactivated or returned to the United States until there remained in the European Command only two tactical organizations —the 15th Hq & Hq Chemical Base Depot Company and the 63d Chemical Base Depot and Maintenance Company. The last unit to disappear was the 193d Chemical Depot Company which was inactivated on 1 September 1948, with the closing of the St Georgen Captured Enemy Toxic Materiel Depot.

One of the most important activities of the Chemical Division, European Command, for many months was the collection and disposition of captured Enemy Toxic Materiel in the American Zone. The five German chemical warfare depots in the Zone were taken over and all toxic war materiels wherever found, whether in filled munitions or in bulk storage, were removed to these depots for disposition. A total of a little more than one hundred thousand tons was disposed of by demilitarization for scrap metal content of containers and for some of the contents as useful commercial items, destruction of bulk agents in place, by shipping to the US and her Allies for examination and by sinking at sea. This work was completed in August 1948 when the last depot at St Georgen (in Southern Bavaria) was closed and converted to peaceful usage.

The munitions found in Germany consisted of artillery and mortar shells, rockets and bombs filled with smoke, lachrymator, sternutator, vesicant and lung irritants of many kinds. Included were mustard of several kinds, lewisite, chlorpicrin, phosgene and Tabun. The fillings and shells were of German, Russian, French, Hungarian and Italian manufacture and filling. The ammunition of non-German origin had been captured by the German army in the countries indicated.

The St Georgen Depot was one of the most interesting, modern and complete. At the peak of its operation the Germans employed in that depot, about 1500 soldiers and civilian laborers plus about 80 girls of the German Work Service. It is described in the official "History of Captured Enemy Toxic Munitions in the American Zone, European Theater, May 1945 to June 1947," (a supplement to this history has since been added). The following is an extract from the history:

"The St Georgen Depot was surrendered to the invading American Forces 3 May 1945 with all facilities in relatively good condition. The Depot is located near the Bavarian town of St Georgen, which contains the ruins of a medieval castle dating back to the 11th centry, and in which it is said that Knights on their way to the Second Crusades, halted for a few hours to rest before continuing their journeys. Depot is not far from the Austrian border, is approximately 50 kilometers from Salisburg, Austria, and about the same distance from Berchtesgaden, Germany.

"The depot was concealed in a heavily wooded area. Buildings and bunkers were built in the woods with a minimum change in the surrounding terrain. This natural camouflage was supplemented with cleverly placed plastic paper in greens and browns. Doorways, entrances, and sides of buildings were cleverly concealed so that detection from the air was all but impossible. The effectiveness of their efforts is evidenced by the fact that the depot was not subjected to any major bombing raids.

"No efforts were made by the Germans to blow up any of the facilities before surrendering, so that the entire installation was turned over to the Americans intact.

"The depot comprises an irregularly shaped, heavily wooded area about 2¼ miles long by 1¼ miles wide. At one end of the depot is the regular munitions area, which contains administrative buildings, barracks, mess halls, motor pool, munitions bunkers, munitions houses and hangars used for assembling, storing and shipping of 105 mm and 150 mm artillery shells. This area is oval in shape with a diameter of approximately 1¼ miles.

"Beyond the munitions area at the

other end of the depot, is the "N" or toxic area, which contains huge tanks for storage of bulk mustard, also buildings containing modern and elaborate machinery for the filling, storing and shipping of toxic artillery shells and land mines."

The Chemical Division, EUCOM, is composed of a number of branches. One of the more important is the Technical Branch. It assists in the preparation of technical advice for the Commander-in-Chief, EUCOM, on all subjects for which the Chemical Corps Department of the Army is responsible. It maintains a laboratory at the Hanau Chemical Corps Depot at Hanau, Germany. This laboratory, among its other activities, conducts acceptance tests of materials purchased by the European Command in Europe. Some examples of these many materials are brake fluids, paints, lacquers, anti-freeze solutions and metal alloys. Another activity is the conduct of surveillance tests on all stored items in the EUCOM for which the Chemical Corps has supply responsibility.

Since the opening of this laboratory in 1948 it has saved the European Command much money directly, but it is estimated to have contributed much more to the Command through the prevention of the use of substandard and unsuitable materials containing ingredients harmful to equipment. The laboratory is installed in rooms excellent for the purpose and is equipped far better than the Field Laboratory Company for which it is a cell or cadre organization. The personnel are competent with a civilian technical director and an officer chemical engineer in charge. The staff includes technically qualified enlisted and civilian chemists, chemical engineers and technicians. Much of the equipment was built in the depot shops. There is an excellent library, balance room, muffles, compressed air, vacuum, distilled water line and most other normal laboratory services and equipment usually found in an industrial or college chemical laboratory.

The Hanau Chemical Corps Depot, located near the City of Hanau and in the Hanau Sub-Post of the Frankfurt Military Post, is the Chemical Division's depot. It is about ten miles east of Frankfurt. Its warehouses afford excellent storage, and are arranged to facilitate rapid loading and unloading of motor transport. They are dry, clean and well lighted. Spare parts storage, prevention of deterioration, record maintenance and control of receipts and issues are in accordance with the best industrial practice and regulations. The 15th Hq & Hq Chemical Base Depot Company and the 63d Chemical Base Depot and Maintenance Company are stationed here. The 63d moves away from the Depot and joins the US Army in Europe during maneuvers and is self-supporting in the field. The 15th also becomes fully self-supporting and all personnel and officers move into the field under canvas during maneuvers. At one time the 63d Chemical Base Depot and Maintenance Company had a secondary mission as a 4.2" Chemical Mortar Platoon in addition to its regular duties.

In addition to the laboratory there are excellent supporting service facilities such as automotive maintenance shop, carpenter shop, metal working shop and others generally equal in efficiency and capability to those in similar establishments in the United States.

Heated, well-lighted and roomy offices are conducive to the good work that contributed much to the excellent record the depot has made in supply administration.

When the Chemical Division took control over the Hanau Chemical Corps Depot in 1947 it was in a badly run down condition—practically all glass and doors had been shattered by bursts of "near misses" in the 1945 Allied air attacks and roofs were leaking. Many of the ammunition bunkers had been partially destroyed by German demolition squads, when the Wehrmacht retreated. As a result tens of thousands of rounds of fuzed live ammunition of various calibers, land mines and other dangerous material were buried in a tangled mass of concrete and steel. There were dud bombs and fused shells scattered all over the area. The roads were a series of chuck-holes. Shop equipment was sparse and what was there was damaged and non-operative. The buildings have now been completely repaired. Offices have been set up with adequate heating and lighting, the roads are now good and the damaged bunkers have been rehabilitated or removed and the buried and scattered ammunition removed and demilitarized.

The two companies are quartered and messed in permanent barracks in the troop area adjacent to other units of the Signal Corps and Engineer Corps depots. They have their own attractive Hanau Chemical Corps Depot Enlisted Men's "63 Club." The enlisted personnel have duties which are above average in interest and variety and they are the equal of any in the theater in intelligence, capabilities and morale.

The officers of the Chemical Corps, on duty in the European Command, although few in number compared to the other technical services, are in many instances on assignments where they are the only officer of their Corps present in a large command or other important unit; for example: One Chemical Corps officer with an Army division, one with the laboratory. This situation calls for all officers to have adequate previous indoctrination and training, initiative, adequate personality, a high sense of duty and the drive necessary to carry through. It is a great satisfaction to know that they have these qualities.

At the end of the war there was a large quantity of chemical equipment in the European Command in need of repair and rehabilitation. This work was initiated at an early date and efficient model assembly line procedures were set up and used in inspection, repair and rehabilitation of all Chemical Corps gas masks, munitions and equipment in the European Command. This work resulted in an estimated saving to the Government of more than a million dollars. Because of its initiative in making an early start on this work, the Chemical Division completed, many months ago, the rehabilitation of the backlog of the material for which it is responsible in the European Command.

In the autumn of 1948, a school was established for the teaching of the tactics and techniques of the Smoke Generator Company. The Chemical Division was composed of so few officers at that time that it was necessary to obtain an officer from the Chemical Corps Board, Army Chemical Center, Maryland, for temporary duty in the EUCOM. He was specially qualified and conducted an excellent school at the Hanau Chemical Corps Depot. As a result Smoke Generator Companies participated in and used smoke in the Spring and Autumn Maneuvers of 1949. Even tho the number of personnel under the control of the Chief of the division is small, cooperation by other units of the European Command and by the Office, Chief, Chemical Corps, Department of the Army, make it possible for the division to perform its mission and to meet any emergency.

The Chemical Division, EUCOM is fully prepared to again assume an important highly technical role as a part of US Army in Europe if and when war comes.

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V-2 ROCKET WITH CHEMICAL CORP SMOKE GENERATOR USED FOR TRACKING PURPOSES
". . . demands upon our scientific manpower will strain our resources to the utmost."

SCIENCE IN NATIONAL DEFENSE

CONTINUED AND INTENSIVE MILITARY RESEARCH IS A PARAMOUNT ELEMENT IN OUR NATIONAL SECURITY. IT REQUIRES THE FULL SUPPORT OF ALL THE CITIZENS OF THIS COUNTRY, BUT PARTICULARLY THE SUPPORT OF THOSE IN THE SCIENTIFIC AND ENGINEERING SEGMENT OF OUR POPULATION.

By Brig. Gen. Wendell Westover ORC*

It augurs well for the security of our country that we take cognizance of the inestimable influence of scientific research and industrial "know-how" upon the preservation of peace.

Within our lifetimes, America has twice defeated attempts of aggressor nations toward world domination. It is obvious that no future aggressor will fail to make the United States the target of initial attack.

Our known readiness, psychological, scientific, and military promises the most effective deterrent. Should we have to fight a war in the immediate future, we would in all probability have to fight it with only slightly improved versions of our World War II weapons. Atomic explosives, radioactive materials, and chemical agents all give promise of results as military weapons on a scale thousands of times greater than is possible with our conventional weapons, but their use has not been perfected and when perfected and used, it is problematical as to whether the end result achieved in the form of a ravaged world would justify their means. Continued and intensive military research is, therefore, a paramount element in our national security. It requires the full support of all the citizens of this country, but particularly the support of those in the scientific and engineering segment of our population.

BRIG. GEN. WENDELL WESTOVER
"Scientists are indispensable"

For the purpose of this article I will use the terms "scientist" to refer to all those who occupy themselves with technical matters; be they research, development, production or testing, so long as the activity is prosecuted at a professional level. Should our nation be called upon to defend itself at any future time, our scientific strength will be determined by the number and calibre of our technically trained and experienced manpower plus the physical facilities available for these functions.

It is pretty obvious that any future international emergency will find us considerably outmanned. We will also lack adequate domestic supplies of many strategic materials, and our domestic supply of several others has been depleted. Hence, even in addition to the operation of increasingly complex military equipment, we must depend on technical superiority to overcome our manpower and resource shortages. This would suggest that other things being equal, victory in any future conflict will depend in large measure on optimum utilization of the scientific manpower.

*For the past two years General Westover served as the Executive for Reserve and ROTC Affairs, Department of the Army. A veteran of the two World Wars, General Westover was recalled to active duty in 1947 at the request of General Eisenhower who desired his services in relation to promoting the postwar Reserve Corps program. In November General Westover requested return to inactive duty to resume direction of his extensive business interests.

Insofar as the Army is concerned, its scientific manpower needs will be met from four major sources. These are:

a. First, those regular officers who have experienced scientific training and who at some time in their career have functioned as scientists. It must be remembered however, that the majority of these officers will be professional soldiers first and scientists second, and that our system of rotation will normally prevent them from being outstanding experts in the scientific field.

b. Second, the Reserve officers who follow science as a profession but who because of their training and experience are also competent in the military art. By comparison with regular officers, most of these individuals will be experts in technical matters but much less expert in the details of the military profession.

c. Third, civilian employees in Army laboratories who are expected to furnish continuity to the technical programs of the Service while most military personnel are rotated periodically from job to job. Many of these civilian employees are of high technical calibre and furnish a type of experience and guidance to our technical activities which can be secured from no other source.

d. Fourth, the national civilian body of scientists who will be available for work as civilians or as uniformed personnel in event of a national emergency, but who must also be called upon to staff our strictly civilian activities in industry, research and development laboratories, and in government.

The total of all these is probably no more than a half-million individuals. They compose less than 1% of our total labor force. Yet, upon them will depend our entire technical effort should war come again.

Science in National Defense

World War II demonstrated that science and scientists will hereafter play an increasingly important role in warfare. The enormity and complexity of present research and development programs sponsored by the military establishment support this conclusion. Any war of the future must involve the closest possible teamwork between science, industry, the civilian economy and the military establishment.

Yet when we look at the record of World War II based on a study recently completed by the Research and Development Group, we find that our utilization of scientists was not good. One of the major causes of our inefficiency in the application of scientists to warfare was our lack of knowledge of the specific application of the various fields of science to military functions and operations. The time for analysis of these applications is during the peace, while we have the time, if we will take it, to apply the results of this analysis to our planning for future defense.

In this connection, if one looks ahead to a possible emergency, he can discern six areas which will call upon our national supply of scientists. These are: (1) The military services; (2) National civilian health and medicine, sanitation, etc.; (3) Civilian facilities such as communcations, transportation, light and heat; (4) Industrial research, development, testing and production to support the military effort and the civilian economy; (5) Non-military research and technical activities such as those carried on by the Department of Agriculture and the Weather Bureau; (6) Educational activities on a reduced but significant scale.

In all of these, scientists are indispensable, and the demands upon our scientific manpower will strain our resources to the utmost.

This supports the conclusion that we must husband these resources and allocate them as carefully as we can in terms of realistically determined requirements in each of these categories of demand.

So far as the Army is concerned, science and scientists will encompass activities from the combat zone to the industrial plant; the research and development laboratory, the zone of communications, theatre headquarters, and a wide variety of other miscellaneous, functions. If these are to be performed effectively, we must insure that the latest developments in science are applied to them and that the operating positions are filled by men of appropriate personal and technical stature.

Requirements for Adequate Mobilization

In order to reach the highly desirable goal whereby we may fully apply our scientific manpower resources to the mission of the Army both in peace and in war, it seems reasonable to assume that we must first evaluate the applications of all fields of technology to the stated mission and to the details of Army functions and operations. It is granted that changes in the nature of warfare, or expansions in the horizon of technical knowledge, may cause these applications to change unexpectedly. Nevertheless, if we have this basic information, which we apparently did not possess in World War II, and which we apparently do not possess today, we will have a sound operating base from which modifications can readily be made.

It is not enough however, merely to recognize that technology can play a particular role in a particular operation. It may be necessary, as a result of these findings, to abandon some of our traditional concepts of tables of organization; to modify the methods by which we evaluate positions and select the individuals who will fill them. Just as the tank has replaced the horse, it is entirely possible that technical developments in

TRAINING SESSION OF NEW YORK'S 1021ST ASU CHEMICAL PROCUREMENT DISTRICT

". . . initiative must come both from the Army and from the individual officer."

the future may bring forward entirely new concepts of military operations.

But again this is not enough. We must devise a practical system by which the right scientist can be placed in the position which he ought to fill, so long as those positions are available. It means that we must have a functioning classification and assignment system adequate to evaluate the complex background and training of the working scientist, and to match them effectively with the needs of technical positions of all levels of complexity. This will require careful technical job evaluations so that we know the technical training and experience requirements of each job.

If we are to follow, in any future conflict, the tried and conventional manpower procurement methods which we have utilized in the past, and which are on our books today as the 1948 Selective Service Act, the Army will probably be supplied with larger numbers of trained scientists than will be required to fill positions at the professional level. Once these positions are filled with men of adequate technical and personal competence, there will remain larger numbers of positions for which in the past we have trained many technically untutored individuals literally from scratch. Yet every scientist has in his basic training a variable content of technical information which may apply more or less equally to a wide variety of generalized technical activities. It would seem appropriate, therefore, that we should have at our disposal a series of simple and readily understandable conversion tables which could be utilized by classification and assignment personnel for the assignment of scientists which we are unable to place in specialized positions. This would reduce materially the amount of special technical training which we were forced to supply during the past war, and should lead to a material reduction in time and effort to be expended.

If this task is accomplished realistically and with a severely practical attitude, we should soon possess a practical working list of the scientific skills we need for the military positions which require a professional level of competence; and secondly, a generalized list of the number of technically trained individuals which we can utilize in the positions of a lower technical level. We then will have a measure of our scientific manpower requirements which we can match against against our Reserve component, if it has been properly analyzed. This statement of requirements can also be utilized by such agencies as the National Security Resources Board in its evaluation of manpower planning for the entire nation.

Role of the Reserve Officer-Scientist

During any period of mobilization the Army leans upon the Reserve officer, with his dual knowledge of civilian and military arts, to staff Army activities of all kinds. The regular officers who are experts in military operations can form only the framework of the expanded military structure. The Reserve Officer therefore plays a strategic role. The Reserve officer-scientist should be prepared, by his peacetime training, to fill the uniformed positions which require a high degree of technical competence as well as a knowledge of Army operations, and thus relieve the regular officer for other duties.

Thus the role of the Reserve officer during a period of peace is to prepare himself as effectively as possible for rapid and effective assumption of active duty. The Reserve officer-scientist, being particularly concerned with technical matters, and anticipating that he will be called to active duty status in an assignment which will utilize his technical competence, bears the responsibility for keeping generally abreast of Army developments, and specifically conversant with Army technical functions and operations. I am not unmindful that there is a dual responsibility here—initiative must come both from the Army and from the individual officer.

Because of his technical competence and his continuing interest in both technical and Army affairs, the Reserve officer-scientist also has a responsibility to assist the Army in solving its technical problems. The Research and Development Organized Reserve program was specifically designed to make this possible. May I emphasize that all the problems which need solving are not those readily discernible by persons who are part of the Army Organization. Just as a commercial firm may call in an outside organization to objectively analyze its staff and operations, so can the Reserve officer-scientist from his position outside the routine day-today operations of the Army organization discern problems which may have escaped the scrutiny of those on the working staff. Provision has been made for initiative in these cases by proposing projects, and Reserve officer-scientists are encouraged to maintain a continual awareness of any possible gaps in the Army program.

Finally, the Reserve officer-scientist has additional prerogatives and responsibilities as a citizen. The establishment of an adequate national defense is of vital interest in all aspects of his tripartite role as a citizen, scientist and officer. In consonance with our fundamental democratic concepts of citizenship, it is his individual and collective responsibility to insure that his skill in science, and the collective scientific resources of the nation, are appropriately and effectively applied to our defense if the occasion should arise.

Weapons—Equipment—Techniques

Conduct of research and development activities of the Army within the scope of policy and objectives established by the General Staff is a responsibility of the technical services.

In general, research and development in weapons and equipment are directed toward obtaining the following characteristics: decrease in both size and weight; adaptability to transport by man and aircraft; simplicity of design for operator efficiency; interchangeability of components and parts; ease of maintenance; use of standard commercial components when practicable; producing items of use to the civilian economy; minimum use of scarce or critical materials; and ease of production in quantity.

Specific research and development projects are directed toward fulfilling the following requirements:

1. Air transport of the standard infantry division.

2. Effective aerial resupply of large units.

3. Short, medium and long-range antiaircraft weapons useful against targets travelling at supersonic speeds.

4. Operationally effective surface-to-surface and surface-to-air guided missiles and necessary facilities and instrumentation in connection therewith.

5. A superior line of armored vehicles.

6. Weapons and ammunition having increased armorpiercing capabilities.

7. A series of field radio sets permitting intercommunication among all command echelons.

8. Superior, light-weight wire communication and terminal equipment, including facsimile.

9. Radar fire-control equipment.

10. Improved individual equipment, clothing, and shelters for all environmental conditions.

11. A suitable low-temperature polymer for use as a rubber substitute in cold climates.

12. Reduction of rations in size, weight, and numbers with emphasis on nutritional value and acceptability.

(Continued on page 38)

THE HANAU (GERMANY) CHEMICAL CORPS LABORATORY*

By Alfred Rabl, Ph.D.
and
Lt. Col. Donald H. Hale CC

"DURING THE PERIOD OF OPERATION THE LABORATORY HAS GRADUALLY TAKEN ON A SECONDARY MISSION—THAT OF PROVIDING TECHNICAL ASSISTANCE AND CHEMICAL AND PHYSICAL TESTING FACILITIES FOR ALL AGENCIES OF THE EUROPEAN COMMAND."

The Chemical Division operates a small laboratory at the Hanau Chemical Corps Depot. This laboratory was organized as a division of the depot in 1948. The initial laboratory equipment came from a chemical field laboratory. This equipment has been slightly augmented during the period that the laboratory has been operating.

The primary mission of that laboratory is to assist with the surveillence of the Chemical Corps items of supply stored in the depot. The laboratory works out surveillence procedures and also runs actual chemical and physical tests in support of the surveillence program.

During the period of operation the laboratory has gradually taken on a secondary mission. This secondary mission is that of providing technical assistance and chemical and physical testing facilities for all agencies of the European Command. This laboratory is the only such laboratory available to the ground forces in the command.

During the past year the laboratory has run several hundred tests for various agencies in the command. The following list of projects which were completed in the past year gives an idea of the variety of the work done:

(1) Research on the recovery of used German anti-freezers.

(2) Investigation of German brake fluids.

(3) Analysis of steels and non-ferrous metals.

(4) Analysis of water treatment chemicals.

(5) Testing of German paints.

(6) Identification of unknown chemicals found at depots.

Much of the testing and analyzing work was done as a quality check of supplies which various agencies were procuring. It is useless for the procuring agency to set up quality standards unless it has available the means for measuring quality. German laboratories are available and are used by the Army's interests are best protected by its own laboratory.

Not all of the laboratory's testing work consists of the actual testing of samples. The laboratory often is asked to work out a test procedure for determining the quality of some item and the actual testing is then done in a German laboratory. The Chemical Corps laboratory may then check the German laboratory by re-testing certain samples after the German laboratory has made its report.

A study of the testing work done in the Chemical Corps laboratory for the month of August 1949 shows that the cost of the work, had it been done in German laboratories, would have been nearly DM 22,000. This estimate of the cost is based upon the "Allgemeines deutsche Gebuehrenverzeichnis fuer Chemiker" (list of prices for chemists). The table below lists the tests run during the month and the estimated costs if the work had been done outside the Chemical Corps laboratory:

Work Done for Outside Agencies—August 1949

Job	No. of Samples Tested	Estimated Cost—German Laboratories
Analysis of steel	2	DM 141.60
Analysis of nickel	2	180.00
Analysis of paints	54	11,000.00
Analysis of wax	1	60.00
Identification of bottled gases	9,500	9,500.00
Analysis of chemicals for safety in storage	15	390.00
Analysis of DDT	2	204.00
Analysis of varnish	1	200.00
Analysis of automotive valves	4	292.00
Total		DM 21,967.60

The report of cost and performance for the Hanua Depot for the month of August shows that the entire operating expense for the laboratory for the month was $2,613.73. Even at a 23.8 cent Mark rate, the operating cost was less than the value of the services rendered other agencies, although the laboratory carried out its primary mission of surveillence during the period.

HANAU'S CHEMICAL LABORATORY
It has saved the European Command much money directly . . .
U. S. Army Photo

*This article discusses some of the activities of the Chemical Corps Depot at Hanau, Germany. It was originally published in Management Bulletin of the European Command.

THE FILTRATION LAW FOR AEROSOLS

By S. H. Katz
Technical Command
Army Chemical Center

During an investigation of the Bureau of Mines on dust respirators after World War I tests were made of the efficacies of various filter materials such as cloth, paper, felt, and absorbent cotton, for restraining aerosol particles (5). The aerosols then employed for testing were tobacco smoke composed of liquid particles of tarry matter suspended in air containing some admixed products of combustion, or solid particles composed of very finely divided silica dispersed in air. Tobacco smoke generated by the process then used had been investigated previously, and was found to consist of quite uniformly sized particles with an average diameter of 0.273 microns and an average size deviation of 1.8 percent (9). The silica consisted of air-floated dust made for polishing, and for the ceramic industries, and was designated "silica smoke." Examined microscopically the silica smoke was seen to consist of particles mostly about one micron in diameter. Although the sizes of the silica smoke particles as employed for testing were nonuniform, they were of the same order of magnitude.

It was found as one result of the investigations that "each layer of fabric in a filter removes apparently the same proportion of the smoke or dust which penetrates to it—and the concentration of the dust does not affect the respective filter actions. (These effects must be stated as 'apparent', as the smoke and dust retained by each layer were not determined separately)." This filtering action occurred before clogging, or other modifications of the filters by deposited material, could change the action. The correlation as expressed above has been confirmed in numerous subsequent investigations, and has been termed the "filtration law" (2), or the "fundamental law" of filtration (7). It has been shown to hold fairly well when a smoke is filtered through relatively coarse activated charcoal granules (4) as well as through the usual aerosol filters composed of fine fibers. That each successive layer in a filter actually restrains the same fraction of smoke which penetrates to it, has been shown by Plummer (7) by means of colorimetric measurements on succesive layers of material after filtering aerosols consisting of a dye dispersed in air. The mathematical relationships have been expressed in varied forms, which are essentially in agreement. That agreement is shown hereunder.

Expressions of Katz, Smith and Meiter

When the early work (5) was done the peformance of filters restraining aerosols was usually expresed in terms of efficiencies, these being the fractions, or percentages, of incoming particles arrested and held by the filters. In subsequent work the performance has been mostly expressed in terms of penetration, which is the portion of incoming aerosol particles passing through a filter. "Penetration" and "efficiency" in terms of fractions are related since the difference between unity and either value equals the other value. The early equation (5) relating the efficiencies of filters with their thicknesses, was:

$$\frac{1}{p} \log (1-E_p) = \log (1-e) \qquad /1/$$

where p = the number of plies of material included in a filter.

E_p = the efficiency of a filter composed of p plies of material, expressed as a fraction.

e = the efficiency of a single ply of filter.

It was also stated (5) that a simpler form of equation, equivalent to equation /1/ may be used:

$$Q = q^p \qquad /2/$$

where Q = the fraction of aerosol particles penetrating a filter of p plies, and

q = the fraction penetrating a single ply.

Equation /2/ follows from substitutions in /1/ based on the relations:

$$1 - E_p = Q \qquad /3/$$

$$1 - e = q \qquad /4/$$

Expressions of Rodebush, and of Lewis

Rodebush (6) subsequently employed the expression.

$$Log_e (N/N_o) = -k\Delta X \qquad /5/$$

where N = number of particles penetrating a filter.

N_o = number of particles entering.

k = a constant.

ΔX = thickness of a layer of filter.

Lewis (6) gave the equation.

$$\frac{N}{N_o} = e^{-kL} \qquad /6/$$

where L = thickness of a filter.

If ΔX is taken equal to L, equation /6/ may be derived from equation /5/ by the same transformations giving equation /2/ from equation /1/.

Lewis stated: "It is readily apparent that if a constant length, L, is assigned as the thickness of a single sheet or layer, then the Katz and Rodebush equations are identical, both expressing the facts that each successive layer, or thickness, filters out the same fraction of the smoke." However, since the identities of equations /2/ and /5/ or /6/ are not quite as obvious as Lewis indicates, their relationship is shown explicitly below.

Equivalence of Equations /2/, /5/ and /6/

According to definitions:

$$Q = \frac{N}{N_o} \qquad /7/$$

Then, after substitutions in equations /2/ and /6/:

$$q^p = e^{-kL} \qquad /8/$$

$$\text{Or: } q = e^{-kL/p} \qquad /9/$$

$$\text{And: } Log_e q = -kL/p \qquad /10/$$

$$\text{Transposing: } k = -\frac{p\ Log_e q}{L} = -\frac{p\ Log_e q}{\Delta X} \qquad /11/$$

may be reduced to equation /2/:

$$Log_e \frac{N}{N_o} = -\frac{(-p\ Log_e q)\ \Delta X}{\Delta X} \qquad (12)$$

$$\text{Or: } Log_e \frac{N}{N_o} = p\ Log_e q \qquad /13/$$

$$\text{And: } \frac{N}{N_o} = q^p = Q \qquad /2/$$

Equation /11/ implies that equations /2/, /5/, and /6/, are equivalent when k equals the negative ratio of the number of plies in a filter, and the thickness of the filter, multiplied by the natural logarithm of the smoke penetration through one ply. In the sense taken here, a ply or layer need not involve physical discontinuity between the successive layers of a filter; successive layers of uniform dimensions in a thick, continuous, homogeneous filter should also permit equal penetrations. Furthermore equation /11/ indicates that any factor affecting the penetration of an aerosol through a single layer of a filter will also affect the value of k.

Conditions Affecting Filtration

Rodebush (8) emphasized that k varies with rate of flow, humidity, particle size, and "probably other factors." Electrostatic charges on particles were considered to have some effect by Katz, Smith, and Meiter (5). The texture of the filters is an important factor. In testing filters a constant rate of flow of air bearing the smoke is maintained, usually 32 or 85 liters per minute through filters of 100 square centimeters surface areas, but lower flow rates are sometimes employed. The humidity of the air and the temperatures involved in generating the aerosols are kept constant for precise determinations. Particle sizes are maintained as uniform as possible although means for accurately and conveniently determining the sizes and their relative abundance are not yet altogether satisfactory: The concentration of the aerosols is not an explicit factor, since the amount of penetrating smoke is directly proportional to the concentration of the influent smoke. No term for concentration appears in equations /2/, /5/, or /6/. However the concentrations are kept fairly uniform, and they amount to fractions of a milligram per liter. Very dilute smokes cause difficulty in observing them visually.

Results of Some Recent Tests

Tobacco smoke is no longer used exclusively as a liquid-smoke medium for testing filters, since it is more convenient now to employ comparable smokes made by quenching the vapor of a high boiling liquid in a stream of air. The apparatus for optically comparing the light scattered from smoke entering a filter and the smoke leaving it has been much improved over that employed to obtain the data reported by Katz, Smith, and Meiter (5). In all the determinations the light scattered from smoke has been considered proportional to the concentration as used.

Experiments of Dinius and Plummer

Some careful experiments with modern optical equipment made to facilitate observations and comparisons of smoke employed in testing filters, were conducted by Dinius and Plummer (1). Several persons made the observations reported by them. They tested a filter paper selected for uniformity, in increasing numbers of layers. Thirteen identical apparatus were employed. Each combined an optical system, a smoke generator, and means for directing and controlling the flow of smoke through filters. One purpose was to demonstrate, by means of the filtration law, the uniformity in size of the liquid smoke particles composed of dioctyl phthalate. This is theoretically possible because the lesser penetration of the larger particles and greater penetration of the smaller particles, if variation exists in the sizes of the order employed, might cause deviation from linearity when the logarithm of the penetration is plotted against the number of layers per filter. The graph obtained with smoke of such mixed sizes should be convex to the axis of penetration. However, if the sizes of particles are uniform the data should show the agreement or disagreement with the linear relationship between numbers of filter layers and the logarithms

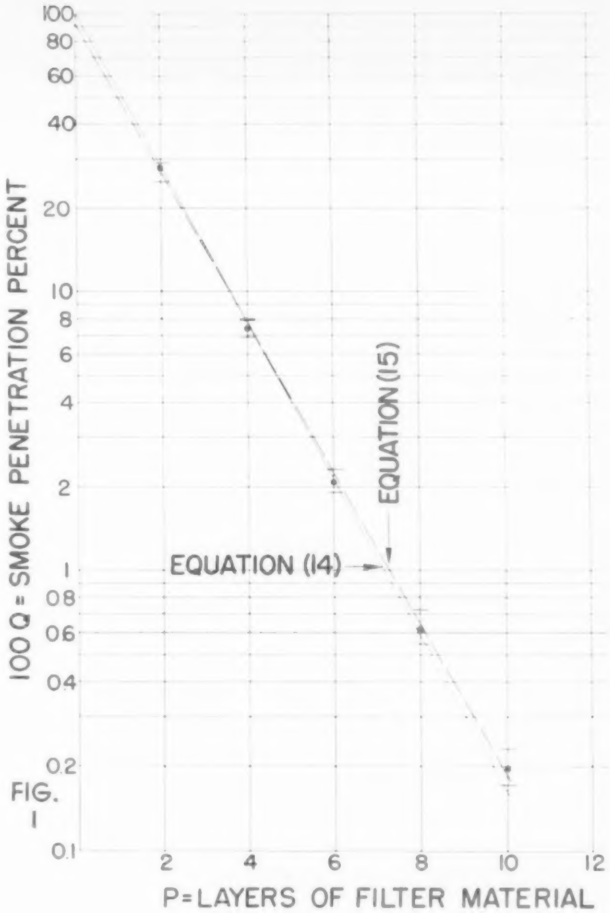

FIG. 1

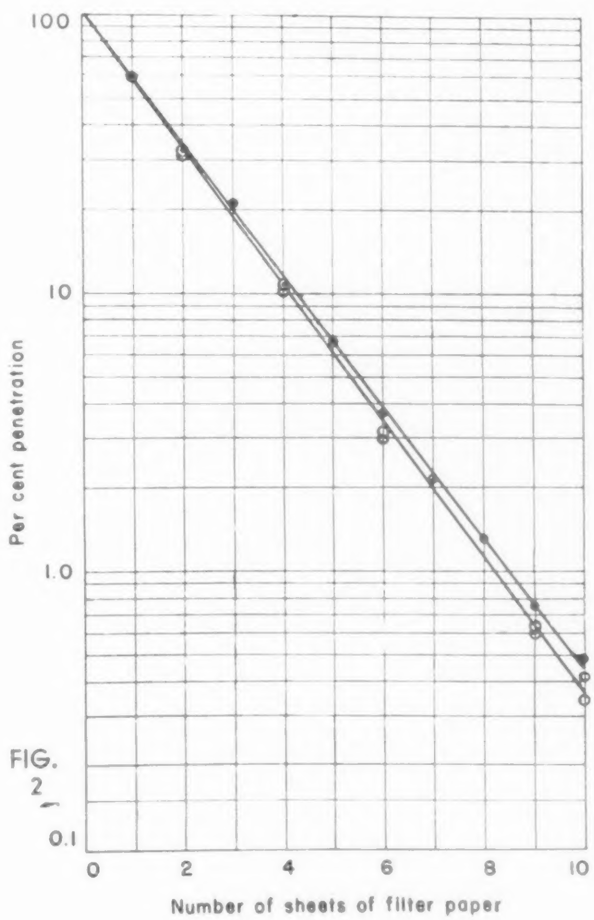

FIG. 2

of the penetrations. The results served also to confirm the approximate uniformity of particle sizes determined first by an optical method based on polarization, and then by a method of settling.

Table 1 gives data reported by Dinius and Plummer (1). The successive rows of penetration values were each obtained with a different complete apparatus. Each number represents the percentage of penetrating smoke determined with a filter composed of previously unused paper. The average percentage penetration of each column in table 1, the standard deviation, and the percentage of the standard deviation based on the average penetration, are given for the filters of each thickness. The greater deviations from the average penetrations found with the thickest filters may be attributed mainly to the greater difficulty in measuring by visual comparisons the dim light scattered from the small amount of smoke penetrating the thickest filters. Table 1 also lists values of penetrations calculated from equations /14/, /15/, and /16/, given below.

Table 1

Penetration of Dioctyl Phthalate Smoke Through Paper Filters Composed of Multiple Layers

Test-Apparatus Number	Observed	Penetration, percent				
		2 ply	4 ply	6 ply	8 ply	10 ply
1	A	28.	7.0	2.0	0.60	0.20
2	B	29.	7.5	1.9	.59	.17
3	A	29.	7.5	2.3	.65	.20
4	A	29.	7.3	2.0	.55	.17
5	A	28.	7.5	2.0	.57	.18
6	A	29.	7.9	2.1	.60	.21
7	C	28.	7.6	2.2	.63	.19
8	A	28.	7.1	2.1	.64	.22
9	A	27.5	7.3	2.1	.60	.23
10	D	27.	7.3	2.1	.62	.19
11	D	29.	7.3	2.2	.62	.19
12	D	28.	7.3	2.2	.72	.21
13	D	25.	6.9	1.9	.62	.21
Average		28.0	7.35	2.08	0.616	0.198
Standard Deviation		±1.08	±0.25	±0.117	±0.040	±0.0179
S.D. Percent of Average		±3.9	±3.4	±5.6	±6.5	±9.0
		Calculated Penetrations:				
From equation /14/		27.7	7.67	2.12	0.588	0.163
From equation /15/		26.3	7.61	2.18	0.650	0.185
From equation /16/		28.1	7.87	2.21	0.620	0.174

Figure 1 shows graphically the relations between the number of plies in the filters and the percentages of the penetrating smokes. The dots show the points denoting the average determinations; the dashes above and below each dot represent the maximum and minimum values obtained. The graphs on figure 1 represent equations /14/ and /15/ hereunder, calculated according to the method of least squares by T. M. Vining, Physical Sciences Statistician, of the Technical Command. The two graphs on the figure show the most favorable and least favorable interpretations of the data according to the filtration law. Equation /14/, showing the best interpretation, is:

$$\text{Log } (100Q) = 2.00 - 0.279p \qquad /14/$$

This equation, represented by the solid line on figure 1, is based on a point fixed theoretically at 100 percent penetration of zero plies, and on the average penetrations of 2 plies to 8 plies inclusive. The data from the filters composed of 10 plies is excluded as least reliable. Equation /14/ may be transformed to the same forms as equations /1/ or /2/.

Equation /15/, giving the worst interpretation, is:

$$\text{Log } (100Q) = 1.96 - 0.269p \qquad /15/$$

This equation, represented by the broken line on figure 1, is based solely on the averages of all the experimental data obtained with 2 plies to 10 plies inclusive. The fixed point of 100 percent penetration for zero plies is excluded from the calculations. The intercept on the ordinate for zero plies has a value of 90.6 percent instead of 100 percent required by the filtration law.

Another equation is of interest:

$$\text{Log } (100Q) = 2.00 - 0.276p \qquad /16/$$

Equation /16/ is based on all the averages of penetration, that is through 2 to 10 plies inclusive and on the penetration of 100 percent for zero plies taken as a fixed point. Equation /16/ is not represented on figure 1 as it would lay closely above the graph of equation /14/. The greatest spread would be at the ordinate for 10 plies where the intercepts would represent 0.163 percent for equation /14/ and 0.174 percent for equation /16/.

The data in table 1 do not agree very precisely with the graphs. As mentioned before, equation /14/ probably most nearly expresses the actual penetrations. Although the points on figure 1 may indicate a tendency toward lesser penetration of the thinner filters, and greater penetration of the thicker ones, than would be expected from the filtration law, such effects are not regarded as typical. Dinius and Plummer accepted the smokes from their generators as sufficiently uniform. More precise measurements made subsequently gave a better basis for such acceptance, as stated next.

Results of Gucker, Pickard, and O'Konski

Gucker, Pickard, and O'Konski[3] developed a photoelectric apparatus for determining light of low intensities in order to measure aerosol concentrations. Such apparatus is much more sensitive than the eye in detecting minute amounts of light, and in distinguishing small differences in the light of higher intensities. Their smoke was composed of dioctyl phthalate, and was produced in a generator like that of Dinius and Plummer[1]. The filter paper tested by Gucker, Pickard, and O'Konski was similar but not identical with that tested by Dinius and Plummer. However the penetrations obtained in the two separate investigations were nearly the same. Figure 2 reproduces the data which were published in graphical form by Gucker, Pickard and O'Konski.[3] The greater precision obtained with their apparatus yielded penetration measurements conforming closely to linear graphs passing through the point of 100 percent penetration. The two graphs in figure 2 represent two series of tests. The results obtained by Gucker, Pickard and O'Konski correspond quite well with those expected from the filtration law represented by the linear graphs on figure 2.

Summary and Conclusions

The filtration law states that each equidimensional layer of material in a uniform filter removes the same fraction of uniformly sized aerosol particles which penetrates to each layer. The law has been given several mathematical forms by different investigators. These expressions are shown to be equivalent. The simplest form is $Q = q^p$.

Data obtained by visually estimating light scattered from smoke penetrating filters, deviates more from the filtration law than data obtained from photoelectric measurements. The better agreements between the photoelectric measurements and the filtration law is attributed to the greater sensitivity to light of the photoelectric cell.

It may be concluded that the filtration law, first formulated from the results of measurements based on visual comparisons of smoke penetrating filters, has been confirmed by more precise measurements made photoelectrically, and that it closely represents the action occurring in the filtration of uniformly sized aerosols.

Bilbiography

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WITH THE ULTIMATE OBJECTIVE TO TRAIN A PROFESSIONALLY COMPETENT CADRE OF OFFICERS WHO WILL BE ASSIGNED TO PROCUREMENT INSTALLATIONS AND MOVE EFFICIENTLY INTO PROCUREMENT FUNCTIONS WITHOUT EXTENSIVE TRAINING, 94 OFFICERS OF NEW YORK'S 1021ST ORASU UTILIZE A MAXIMUM OF REALISM.

←CHEMICAL PROCUREMENT TRAINING

By Lt. Col. Joseph F. Escude

Commanding Officer

New York Chemical Procurement District

Chemical Corps Reservists of the 1021st Organized Reserve Army Service Unit (ORASU) of New York City, are actively engaged in a special training exercise known as the Chemical Corps Procurement District Training Program. This training program is under the direction of First Army and the Senior Army Instructor for the state of New York; it is designed to prepare a trained nucleus of Chemical Corps reservists for immediate assignment to any Chemical Corps Procurement installation. In achieving this objective, the 1021st ORASU will be fulfilling its part of the overall ORC training program for Service Type Units in support of the mobilized forces of any future M-Day.

The problem prepared by members of the 1021st ORASU in conjunction with personnel of the New York Chemical Procurement District, encompasses a two year training program which began on 1 July 1949 and will continue to 29 June 1951. Reservists are working in groups of five and six and are organized into operational divisions and branches executing simulated wartime functions normally assigned such units. They meet twice a month in the offices of the New York Chemical Procurement District, at 111 East 16th Street. Here, chemical officers and procurement specialists guide the reservists in the performance of the exercise which is carried out with a maximum amount of realism.

The Procurement Training Exercise was developed to incorporate industrial Mobilization Planning activities, and implements the preparedness measures to be effected on the theoretical M-Day.

Activated on 27 December 1948, the 1021st ORASU under the command of Colonel Samuel N. Cummings, is placing primary stress upon the training of its 94 officers in chemical supply and procurement to fill specific M-Day assignments. The ultimate objective is to train a professionally competent cadre of officers who will be assigned to procurement installations and move efficiently into procurement functions without further extensive training. Officers are selected on the basis of their war record with the Chemical Corps in supply and procurement, or they may be civilians presently engaged in similar work.

Chemical supply and procurement has become such a highly specialized field, as a result of the world-wide operations of World War II, that the Chemical Corps has placed it within one of the three main divisions of its officer classification scheme. An officer's future assignment and promotion may be based upon his specialization within this field.

Reservists of the 1021st ORASU are therefore being trained with a view toward having a clearly defined sense of responsibility toward a particular job. Accent is placed upon obtaining maximum professional competence within the scope of their assignment. To achieve this objective, the Chemical Procurement Training Exercise presents a realistic situation dealing with the role of supply and procurement during simulated hostilities.

Briefly, the plan consists of a simulated state of war between the United States and Aggressor, a nation occupying a mythical continent in the South Atlantic Ocean. Aggressor forces have occupied Alpha and Beta, twin islands approximately midway between Aggressor nation and New York.

General mobilization has been ordered in the United States with the activation of the Atlantic Theater of Operations. Operation ATLANTA, invasion of Alpha and Beta, has been directed by the Joint Chiefs of Staff as a prelude to a large-scale invasion of Aggressor nation (Operation DOVETAIL).

Integration of the 1021st ORASU into the active New York Chemical Procurement District, Chemical Corps, Department of the Army, proceeds as industrial mobilization plans are implemented into active procurement by direction of Office, Secretary of Defense. It is assumed, for purposes of the exercise, that Chemical Corps materiel end items, and stocks in industrial reserve, are sufficient to support the supply program for all target date requirements.

Disregarding various tactical features of the plan, the overall role of chemical procurement is to support the backbone of military operations from D-Day to anticipated V-Day. In this connection, the plan presents the method of coordinating activities of Schenectady General Distribution Depot, with port of Embarkation, Newark Air Force Base, Eastern Chemical Depot, Technical Command, Army Chemical Center, and the New York Chemical Procurement District.

Specific problems relating to the procurement of Chemical Corps items, such as, gas masks, napalm, protective ointments and kits, flamethrowers, and other materiel supplied to allied arms and services, give the exercise a realistic approach to practical problems. Such problems which arise involving technical, fiscal, legal, production, inspection, transportation and other phases related to M-Day procurement activities, gives Reservists training in specific jobs.

Complete details of the administrative organization of a chemical procurement district, and the duties of the commanding officer and division chiefs, give reservists the opportunity of training in specific jobs and acquiring detailed knowledge of their operational functions on a current basis.

Analysis of procurement schedules, placing of procurement orders with industrial facilities allocated by the Munitions Board, and methods of resolving difficulties encountered prior to, and during actual production, are some other features of the exercise.

Material of the course includes procurement schedules, organization charts of Chemical Corps installations, training directives, aids and

(Continued on page 40)

United States Technical Conference on Air Pollution

(A Journal Staff Report)

The industrial expansion of American cities and new process development, particularly in the chemical, radiological and bacteriological field, make atmospheric contamination one of the most discussed technical problems of the country today. Much has been published in the popular and technical press regarding the subject and many of the departments of the Federal Government are receiving inquiries and requests for assistance in control of atmospheric contamination.

It has been learned from authoritative sources that the President has directed the Secretary of the Interior to organize an Interdepartmental Committee which will in turn sponsor the United States Technical Conference on Air Pollution. The President has, from time to time, sponsored conferences on problems of vital signficance to the people of the United States, among which are the Conference on Highway Safety, the Conference on Fire Prevention, and the Conference on Industrial Safety. In his request, the President asked the heads of the interested departments and agencies to provide the Secretary of the Interior with names of representatives from their agencies whom they desire to serve on the Interdepartmental Committee which will sponsor the United States Technical Conference of Air Pollution.

The Federal agencies will present at this conference information available to them bearing on this problem. The most highly qualified persons in this field, in industry, Government research institutions and other lines of endeavor will be invited to participate and a report summarizing the findings of the Conference will be made available to the public. While it was stated that the contamination of the atmosphere and its potential adverse effects on health, industry, agriculture and natural resources are causing wide concern, it is pointed out that the responsibility for corrective action and the benefits are primarily local in character.

The Interdepartmental Committee has not established a date for the Conference but an April date has been suggested. Preliminary plans are for a three-day conference in Washington at the time selected. It is proposed to divide the Conference into the following panels: Meteorology, Health, Instrumentation and Analytical Methods, Equipment, Properties, Agriculture, Economics, Legislation and Research.

MISCELLANY

Ethyl bromoacetate, a tear gas, was the first combat gas used in World War I. It was employed in rifle grenades by the French as early as August 1914.

* * *

Of the various incendiary materials employed by the Allies in the first World War, thermite was the most widely used.

* * *

The French were the first to use lethal-gas artillery shells in combat. Phosgene-filled shells were used in the Battle of Verdun on 16 February 1916.

* * *

There were 1,296,853 gas casualties suffered in battle by all participating armies in World War I. Of these, only 91,198 were deaths.

THE ARMED FORCES CHEMICAL ASSOCIATION

⭑ WHAT THE ASSOCIATION DOES:

The members of this Association, mindful of the vital importance of chemical warfare in the field of national defense, have joined together as a patriotic obligation to preserve the knowledge derived from their war experiences and to encourage improvements in science as applied to the Chemical Corps. The objects of this Association, therefore, are to sponsor new developments designed to increase the efficiency of chemical warfare means, to collect and disseminate useful knowledge with respect to chemical warfare and related subjects, to foster a spirit of good will and cooperative endeavor among its members and with industry, and to perpetuate the friendships, memories and traditions growing out of their service with the Chemical Corps. The members of this Association and its constituent local Chapters are mutually pledged to the furtherance and promotion of these objects.

⭑ WHO IS ELIGIBLE FOR MEMBERSHIP:

Any person who is or may be assigned or detailed to duty with or in the Chemical Corps, whether as officer, warrant officer, enlisted man or civilian employee, or who has been honorably discharged from such duty, and any person interested in the promotion of chemical warfare preparedness for national defense, may upon approval of the Executive Committee and payment of the annual dues hereinafter specified become a Regular member of this Association.

PASS THIS ON TO A NON-MEMBER OF AFCA—SIGN HIM UP!

To: Fred M. Jacobs, Secretary, Armed Forces Chemical Association
1129 Vermont Avenue, N.W., Washington 8, D. C.

I hereby apply for membership in the Armed Forces Chemical Association. Inclosed herewith is check or money order in the sum of:

Regular membership ....$5 ☐ Student membership ....$2.50 ☐
Group membership ....$100 ☐ Life membership ....$100 ☐

I am a citizen of the United States with a deep sense of the obligation of every citizen to devote himself unstintingly to the cause of our nation's defense whenever the need arises. I have a particular interest in the Chemical phase of national defense.

Name______________________________

Street______________________________

City______________________________

STOCKPILING—IT MAY SAVE OUR SKINS!*

MAJ. GEN. A. B. QUINTON, JR.

OF THE SIXTY-NINE MATERIALS CHOSEN FOR THE NATION'S SECURITY STOCKPILE, ONLY EIGHT ARE PRODUCED IN THIS COUNTRY TO ANY GREAT EXTENT AND ONLY TWENTY-SEVEN PRODUCED HERE AT ALL. HERE ARE THE FUNDAMENTAL PRINCIPLES OF OUR STOCKPILING EFFORTS AND THE REASONS FOR THE EXPANDING "PILE."

By Maj. Gen. A. B. Quinton

Acting Director for Industrial Programs
The Munitions Board

The importance of strategic minerals and materials to the national security was recognized by the Congress in 1946 in the Strategic and Critical Materials Stock Piling Act. This Act, in effect, authorized the setting up of a stockpile of certain materials needed to arm the military forces and to sustain the domestic economy in time of war. The materials to be stockpiled were to be those not available in sufficient quantities in wartime.

Speaking for the Munitions Board—whose function it is to supervise this stockpiling program—we have chosen 69 materials to stockpile. We are buying these materials as fast as Congress appropriates money for the program. To show you the importance of minerals to our preparedness, 51 of the 69 materials being stockpiled are taken out of the ground. Let me add that only 8 of these materials are produced in this country to any great extent and only 27 are produced here at all.

Much has been said in recent months as to how the stockpile program could help solve several of our national problems. We have been urged to buy up the surplus of one mining industry after another, to keep them operating. It is very natural and human, that any businessman wants to keep in business and any worker wants to keep his job. Thus, we have been urged to buy more than our plans call for of copper, lead, zinc, mercury, tungsten, and other minerals produced in the United States to absorb temporary surpluses and keep the mines fully operating. Sometimes we have been asked to make purchases at above the going market price for these materials.

On the other hand many manufacturing industries in the United States depend for their margin of profit on their export trade. The current export situation is not bright, and some of these industries have had hard going. Discussions have been held between the British and our own monetary experts to discover ways to keep alive our trade with British countries. The Munitions Board has been urged to make heavy purchases for the stockpile of tin, rubber and other materials produced in the British orbit, so that the British in turn might buy more manufactured goods from us and thereby strengthen our own manufacturing industries.

Thus, we have been under pressure from two groups urging precisely opposite courses: one seeking to have us buy as much as possible in the United States to support our domestic mining industry, and the other seeking to have us buy abroad to support American exports of manufactured products.

It has been our firm policy, and one that we want to maintain, to conduct the stockpile for its primary purpose and not to deviate to accomplish side objectives. We are stockpiling materials for the national security. If the stockpile should prove helpful to other national purposes, that is well enough. But the tail should not wag the dog. On the other hand, if it should become the policy of the United States to buy minerals or metals for some purpose other than the national security, such a program should not be permitted to injure our national security stockpile.

It may be helpful to set before you the fundamental principles of our stockpiling efforts, and to describe the reasons for the stockpile. I do not think anyone who clearly understands the close relation between military power and raw materials would urge sincerely that our stockpile should be diverted from its principal task.

The Basic Resource

The most basic resource needed to fight a war is manpower. An ample reserve in the stockpile of tin, for example, represents manpower. It took man-hours of labor to mine the ore, to load it aboard railroad cars and bring it to the water's edge, to load it into the ore boats, to bring it to the refinery; it took more labor to mine the coal needed in the refining process, and to bring the coal to the refinery. More manpower again was needed to transport the tin to stockpiling depots located near consuming centers of tin. Obviously, if all this is

The Cost of "Not Enough"

However, the amount of manpower

*This article is based upon the address of General Quinton before the American Mining Congress at Spokane, Washington.

represented by our reserves of 69 materials in the stockpile is infinitesi-
done in advance, time and manpower are stockpiled along with tin.
mal compared with the additional manpower that would be needed to carry out our industrial programs without the use of these materials. Let me illustrate by taking another material—rubber. We did not have enough rubber during World War II—what was the cost of the deficiency in terms of dollars, time and manpower?

It meant that in the midst of a great war the United States had to pour a billion dollars of materials and effort into the building of a huge synthetic rubber industry. Additional millions of dollars—representing more human effort and materials—were spent to start rubber projects in Brazil, Liberia and elsewhere. A costly Guayule plantation was started in California. Oil refinery equipment had to be converted to the production of basic ingredients of synthetic rubber. All these activities took time and manpower. The steel required for our synthetic rubber plants was taken away from other essential programs which slowed our military effort—which meant a further cost in time. And in wartime, time itself has value. The daily cost of World War II to the United States reached about one-half billion dollars. Measured in these terms, the cost of our entire stockpile of 69 materials, when completed, would represent one week of war. Yet it would certainly have saved many times that amount of time, and many times that value, had we had such a stockpile at the outset of World War II. But that is not all the cost of our rubber shortage. The shortage of steel impelled us to undertake the construction and expansion of steel plants which consumed traditional steel. Our efforts to get rubber from overseas meant the building of supply lines and establishment of bases along these supply lines. This took ships and troops, and diverted a part of our military forces from their principal purpose of attacking the enemy. Think then, how many lives, how much manpower, time and dollars, would have been saved had we been able to stockpile all the rubber we needed, before the Pearl Harbor attack!

In the final analysis, we stockpile materials on the basis not of the manpower required to produce them, but the manpower that would be required if we did not have them. The *lack* of any one of the 69 materials being stockpiled would involve us in a tremendous and costly, time-consuming effort to overcome that lack. With certain of these items, the manpower cost might well decide the issue in a future war.

Stockpiling Act

A rough rule-of-thumb measure is provided in the Stockpiling Act to guide us in determining which materials are so badly needed that their lack would involve us in huge, costly, manpower-consuming programs. The Act says that the purpose of the stockpile is to "decrease and prevent wherever possible a dangerous and costly dependence of the United States upon foreign nations for supplies of (strategic and critical) materials in times of national emergency." This rule-of-thumb—our dependence on foreign nations in time of war—we refine still further by estimating our chances in getting materials from these various foreign sources of supply in time of war. It is plain common sense that, in wartime, materials from Canada and Mexico would be less subject to enemy interference than supplies from halfway around the world in India or the Malay Peninsula. It is also obvious that we must make a tremendously greater effort to protect our supply lines to remote points like Malaya and that a lot of time and ships would be required to bring the materials here.

We consider it to be our duty under the Act, and in the interest of the National Security, to stockpile principally those materials produced abroad. Let me repeat that eight of the materials being stockpiled are produced in the United States to the extent of one-half our peacetime industrial requirements; only 27 materials of the 69 are produced in the United States at all.

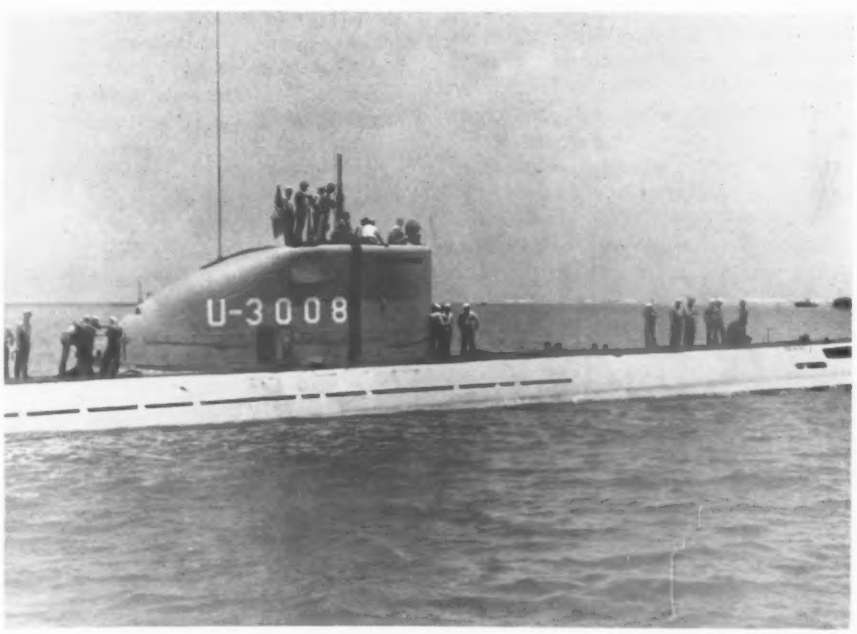
Need For Balanced Stockpile

I can give you a few figures about our stockpiling progress. The stockpile when completed will cost, in current prices, somewhat more than three billion dollars. Our inventory at the end of June contained materials worth a little under a billion and deliveries scheduled through June 1950 will bring our inventory up to about a billion and a half, or about halfway. Another half-billion dollars worth of materials are on order for delivery after the end of next June, which will bring us to two-thirds of the total, and another billion dollars of appropriations will be needed to complete our present stockpile objectives.

These figures suggest that the job is moving along at a good rate. I am sorry to say that this is not entirely the case. Although we have tried to keep the stockpile in good balance, some materials have proved a lot easier to buy than others. As a result, we have completed our objectives for a number of the 69 materials, and certain others are ahead of schedule. Those behind schedule are hardest to get.

This is a serious matter because of the inherent inter-dependence among many of the materials. The need for a balanced stockpile is more than a theory. For example, our steel industry depends absolutely on manganese, but if it had all the manganese it needed, we would still need chromium, nickel, vanadium and tungsten and other materials to form the

A CAPTURED GERMAN U-BOAT HEADS OUT TO SEA
Naval Specifications: At first, 56 tons of copper—At the end, 26 tons!



Stockpiling is not the only way to strengthen the strategic materials position in the United States. One of the most remarkable achievements in recent history was the fact that Germany, an inland empire without adequate copper, petroleum, nickel, tin and rubber was able to wage a first-class war against three powerful industrial countries and to sustain this war for nearly six years. Germany achieved a remarkable independence of outside sources of strategic materials. To be sure, she did build up huge stockpiles. Her chemists found ways to produce petroleum products and rubber synthetically. Great efforts were taken to conserve scrap metal. Weapons were designed so as to use a minimum quantity of critical material. For example, instead of using nickel in small gun barrels, they used vanadium; instead of using vanadium in larger gun barrels, they used molybdenum. Naval specifications for German submarines at the outset of the war called for 56 tons of copper per ship, but at the end of the war they were making a greatly improved submarine using only 26 tons of copper. Early in 1942, German locomotives required 5,000 pounds of copper but by redesign they cut this to 630 pounds.

In some cases, skillful German engineering enabled them to substitute without loss of manpower, but elsewhere the shortages of important materials meant serious losses in efficiency of the product, and increased cost in man-hours of production time.

The point I am getting at is that it is possible to do without any single material we are stockpiling, if we are willing to pay the cost in dollars and manpower and time and even lives. The problem of industrial mobilization is the problem of making the most rapid and most efficient use of the whole range of resources available to us in wartime. The more ineffective substitution of second-best materials we have to make, the heavier is the drain on our manpower, and manpower is the ultimate resource of war. On the other hand, skillful substitution may sometimes be achieved with relatively little loss in efficiency. It should be regarded as an important adjunct of the stockpiling program. Indeed, in the Stock Piling Act itself, the Congress instructed the Departments of Agriculture and Interior to set up research programs to find ways to conserve our scarce supplies of strategic and critical materials, and to develop effective substitutes.

The Job Ahead

We know that we can effect a tremendous saving in lives, time, manpower and dollars if we take a few obvious steps toward self-sufficiency now, instead of waiting to be forced to do so in time of war. Our efforts to strengthen the materials position of the United States, as a national preparedness measure, should always include the stockpiling of materials of which our wartime production would not fully meet our essential needs. But there are other highly important jobs before us. They constitute a strategic materials program, whose overriding objective is to conserve manpower in time of war.

First, our military research people are constantly seeking to develop more effective and efficient weapons and munitions of war. These "military end items" as we call them should be so designed as to use a minimum of materials likely to be short supply in wartime. It is not always possible to predict what materials are likely to be in short supply, because when we turn to substitutes, the substitutes themselves are likely to become scarce. Therefore, our military end items should be designed so that they can be made with not one but several alternative kinds of materials, to preserve a maximum of flexibility in wartime production.

Second, for each end items—military or civilian—there is one material or pattern of materials that is least expensive and therefore most efficient in terms of manpower. In the normal course of events every manufacturing industry seeks to determine this pattern for its own product. The work goes on constantly. We should recognize that this constant research effort of private business is an important part of our national security program. It deserves our strong support.

Third, we should seek the most efficient ways to produce each raw material we use. That means, not only the most efficient mining of accessible deposits, but also the most efficient ways to obtain all the materials we would need to produce in wartime. There is much to be done along this line. It lies close to your interests, and I am sure that we are prepared to support any prudent and businesslike program of research and development to accomplish it. As our richest and most accessible deposits of minerals are played out, our national research programs should have ready at hand the techniques to produce needed materials economically from less accessible reserves.

Fourth, there are some minerals and wasted agricultural byproducts which, though plentiful in this country, have no important strategic uses. each of these materials should be reexamined to determine whether it might become a useful wartime substitute—even though more costly in time and manpower—for some highly critical material. The more we know about all of our minerals, the more useful they become. For example, work has been under way for some time in the Bureau of Mines to improve the technology and commercial usefulness of titanium. Notable research has also been conducted by private industry with silicones and fluero-carbons, with the result that these plentiful materials have taken on a wide range of new and valuable uses.

These are some of the ways in which our minerals position can be strengthened. But inescapably, there will always be a number of basic materials—essential in war—that we cannot produce fast enough, if at all when the need for them is greatest. One of these materials—of which we usually produce more than enough in peacetime, but far from enough for war—is copper. Wartime shortages of these materials breed other shortages. If we do not have enough copper in the stockpile to supplement wartime production, the shortage of copper would be reflected first in shortages of military end items using copper and brass, such as cartridge cases, radios, and field telephones, tanks and trucks, ship engines and radar sets. Second, it would bring about a shortage of wire and cable and machine parts that go into industrial plant equipment and machine tools needed to make a whole range of military end items. Thirdly, it would be reflected in a shortage of facilities and equipment needed to expand the production of copper itself.

It is not easy to summarize the far-reaching impact of the stockpiling program, nor to appraise its contribution to the national security. What I have to say does not apply to a half-finished stockpile, which is what we have at present. It does not apply to a nine-tenths stockpile. But the full stockpile, *when completed*, will contribute to the national security in several important ways.

The principal advantage, of course, is the protection it affords, by providing a margin of supplies to tide us over peak wartime shortages, by replacing supplies which might be cut off by enemy action, and by eliminating the great cost in lives and ships to protect extended shipping lanes all over the world.

The completed stockpile will enable us to concentrate on a few vital supply lines, and to use our military strength on the enemy.

The completed stockpile will en-

(Continued on page 38)

IT'S OFFICIAL

CONTRIBUTIONS TO AFCA ARE "DEDUCTIBLE" FROM TAXABLE NET INCOME

Armed Forces Chemical Association
1129 Vermont Avenue, N.W.
Washington 5, D.C.
Gentlemen:

Reference is made to the additional evidence recently submitted by you for use in further considering your status for Federal income tax purposes under the provisions of section 101 (6) of the Internal Revenue Code.

The records of the Bureau disclose that under your former name The Chemical Warfare Association, 2153 Florida Avenue, N.W., Washington, D.C., you were held not to be entitled to exemption from Federal income tax under the provisions of section 101 (6) of the Internal Revenue Code, but were held to be entitled to exemption from Federal income tax under the provisions of Section 101 (7) of the Internal Revenue Code in Bureau ruling dated Sept 22, 1947.

It is the opinion of this office based upon all the information now on file that you are exempt from Federal income tax under the provisions of section 101 (6) of the Internal Revenue Code, as it is shown that you are organized and operated exclusively for educational and scientific purposes.

Accordingly, you will not be required to file income tax returns unless you change the character of your organization, the purposes for which you were organized, or your method of operation. Any such changes should be reported immediately to the collector of internal revenue for your district in order that their effect upon your exempt status may be determined.

Furthermore, under substantially identical authority contained in sections 1426 and 1607 of the Code, the employment taxes imposed by such statute are not applicable to remuneration for services performed in your employ so long as you meet the conditions prescribed above for retention of an exempt status for income tax purposes.

You will be required, however, to file annually an information return on Form 990 with the collector of internal revenue for your district so long as this exemption remains in effect. This form may be obtained from the collector and is required to be filed on or before the 15th day of the fifth month following the close of your annual accounting period.

Contributions made to you are deductable by the doners in arriving at their taxable net income in the manner and to the extent provided by section 23 (o) and (q) of the Internal Revenue Code, as amended.

Bequests, legacies, devises or transfers, to or for your use are deductible in arriving at the value of the net estate of a decedent for estate tax purposes in the manner and to the extent provided by sections 812 (d) and 861 (a) (3) of the Code. Gifts of property to you are deductible in computing net gifts for gift tax purposes in the manner and to the extent provided in section 1004 (a) (2) (b) and 1004 (b) (2) and (3) of the Code.

Bureau ruling of September 22, 1947 is hereby modified to conform to this ruling.

The collector of internal revenue for your district is being advised of this action.

By direction of the Commissioner.

Yours very truly,
E. I. McLarney
Deputy Commissioner

REPORT FROM EDGEWOOD

Army Chemical Center Chapter

A large and enthusiastic group of over 100 members and their guests attended the Fall get-together of the Army Chemical Center Chapter of AFCA which was held at Conaty Hall on 16 November 1949. All arrangements for the meeting were masterminded by Dr. Floyd A. Odell who worked hard for the occasion, while publicity was handled by Maj. Murdock J. McLeod. The gathering was completely informal and the arriving guests were greeted by a concert which was rendered by the 327th Ground Forces Band under the leadership of M/Sgt. McKinney.

The meeting was opened by a brief word of welcome by Dr. S. D. Silver, President of the Chapter, after which the March of Time film, "Atomic Power," was shown. This proved to be an extremely interesting documentary movie which revealed not only the development of the bomb but the personalities behind it. Following the film there was a break during which peanuts, popcorn, potato chips and cokes were sold by a one-man refreshment committee, Lt. Ogle B. Cope. Meanwhile, Dick Wheeler shot a few candid photos of an unsuspecting audience.

When the meeting was called to order, Dr. Silver introduced Col. T. H. Murphy, Chemical Officer of the 2nd Army, who, in turn, introduced the guest speaker, Maj. Gordon B. Enders, Director of Tactical Intelligence, 2nd Army, who spoke on some of the personalities he had met as an intelligence officer in the Near and Far East. The theme of his talk was "if you wish to know a country well, get your information from the roughest, toughest, most unscrupulous rascal that you can find," and was pointed up by his many experiences with just such people. At the conclusion of his presentation, the audience complained he had quit too soon.

PURELY INFORMAL

Guests at Army Chemical Center Chapter's Fall meeting: Seated, left to right: Dr. Floyd A. Odell, Mrs. D. B. Dill, Mrs. F. N. Marzulli. Standing, left to right: Dr. D. B. Dill, Mrs. H. E. Himwich and Dr. H. E. Himwich.

AFCA CHAPTERS — REPORT YOUR ACTIVITIES IN THE JOURNAL

To stimulate interest and membership in your Chapter—make sure your Chapter progress receives due coverage in the publications of the Armed Forces Chemical Association. Make it a point that your President or Secretary submit a news report to National Headquarters after your next meeting—it pays off in membership!

NEW PUBLICATIONS

The reactivity of some organic substances containing tertiary nitrogen towards mustard gas. Cecil Stora and Henri Genin. *Bulletin de la societe chimique de France* 1949: 72-83.

Lewisite. P. D. Bartlett, H. J. Dauben, Jr., and L. J. Rosen. *U. S. Patent* 2,465,834 (March 29, 1949).

Industrial toxicology. Phosgene. Lawrence T. Fairhall. *Industrial Hygiene Newsletter, U. S. Public Health Service* 9: No. 1, 13.18 (1949).

Purification of titanium tetrachloride. I. J. Krchma (to E. I. duPont de Nemours & Co.) *U. S. Patent* 2,463,396 (March 1, 1949).

2,3-Dimercapto-1-propanol (BAL) and methyl iodide intoxication. Monamy Bucknell. *Nature* 163. 330 (1949).

Preparation, properties, and handling of elementary fluorine. A. J. Rudge. *Chemistry & Industry* 1949: 247-53.

Stability of concentrated hydrogen peroxide. Walter C. Schumb. *Industrial and Engineering Chemistry* 41: 992-1003 (1949).

The magnesium industry in 1948. W. S. Loose. *Modern Metals* 5: No. 4, 13-14 (1949).

Stabilization of sulfur trioxide. H. G. McCann (to Allied Chemical & Dye Corp.) *U. S. Patent* 2,458,718 (January 11, 1949).

Scientific • RESOURCES • CURTAILMENT • SECURITY*

IN EXAMINING THE ENVIRONMENT OF THE CHEMICAL CORPS, WE MUST CONCLUDE THAT THE POTENTIAL VALUE OF ITS SERVICE TO ARMS IS TREMENDOUS AND THAT THIS POTENTIAL IS AS YET BUT FRACTIONALLY DEVELOPED. ALSO, PROPER CONTACT, UNDERSTANDING AND CO-ORDINATION WITH INDUSTRY IS ABSOLUTELY ESSENTIAL TO ITS FUTURE.

By Dr. Ralph L. Evans
President, Evans Chemetics, Inc.

The year 1949 closes after a period of military change that has been trying from many points of view. A growing realization by more of our people of the tremendous cost of the government and its unbearable-in-peacetime tax burden has prompted efforts to effect important economies in the Department of Defense at a time when we are promised an increase in our tax bill and are threatened with a new war. There has been a drying up of national income, the source from which taxes must be derived.

The resulting pressure for economy in national expense comes in the midst of cold war. It comes at a time when we are told that we are no longer the sole possessor of our most publicized weapon—the atom bomb. It comes at a time when demands are made for us to support still more fully all of the vast miscellany of foreign projects absorbing billions and billions of dollars of our tax money.

The resulting squeeze forces us to stop, look, and listen. From this forest of confusion we must return to first principles and again examine our position, our objectives and our tools. We must again chart our gains and our losses. We must carefully and still more carefully plan our course ahead.

Whether another war is inevitable is beyond the scope of this article. Perhaps, it can be avoided, but we must insure against the calamity. I would like to discuss the present and future rolls of the Chemical Corps—"la raison d'être" of the Armed Forces Chemical Association.

As yet the Chemical Corps is still a service branch. That is, it is not a primary moving, attacking, occupying service such as infantry, fleet, air or artillery. It serves more like the Engineers Corps or the Ordnance Department in that it provides certain classes of weapons of attack and certain types of defense to troops not skilled in chemical warfare. Its officers and enlisted men are technically and usually scientifically trained to guide, support and protect the masses of fighting troops.

One of the most important functions of the Chemical Corps is to conceive and to design chemical weapons and defenses. Coupled with this primary object is the corollary of directing industrial production of these means. The field of interest has been alphabetized as Atomic—Biological—Chemical or ABC.

If we functionalize the Chemical Corps we may place it in the category that is sometimes referred to as instrumentation, more recently called cybernetics. It is thus an instrument to collect information, classify it, interpret it, and direct it into proper channels. It records this information, translates it into needs and informs others concerned. It then acts as a servo-mechanism to launch industrial production and make the product available to the fighting forces.

In examining the environment of our instrument, the Chemical Corps, of such defensive arms including a three point training course for the military, industrial and civilian populations to afford maximum protection from attack even when defensive material is limited or lacking;

e) Long range ABC planning emphasizing research and development—not only to provide advanced weapons, designs and concepts, but also to pilot these items to the threshold of production for war.

Although I have placed research and development last, chronologically it must come first and, in fact, for any given item, it must begin many years before its use for war is an accomplished fact. Because special knowledge and techniques are required of those who conceive, design and develop these new items, the number contributing to this phase is limited and must be chosen mainly from the rolls of the nation's scientists. Either or both of two general plans may be adopted in tapping this scientific reservoir of knowledge and skill.

One solution may be a staff of experts, well-rounded in fields concerned. These men may be equipped with laboratories and apparatus and charged with the task of keeping the nation out in front in the race for military effectiveness. Such a program and its parts becomes classified of necessity and there is a tendency to draw within the military enclosure—to play the cards close to the chest. A system resembling education in the Middle Ages may result. A cloistered inner group, isolated from the mass of the we must conclude that the potential value of its service to arms is tremendous; that this potential is as yet but fractionally developed; that the

*This article is based on the address of Dr. Evans to the New York Chapter, Armed Forces Chemical Association.

full utilization of the apparently unlimited capacities and resources of chemical and related industry is indispensable; and that proper contact, understanding and co-ordination with industry is absolutely essential to enable the Chemical Corps to guide the achievement of mammoth output.

We can, therefore, arrive at an expression of the peace time—or shall we say pre-war time—objective of the Chemical Corps and can determine it as including:

a) The maximum ABC contribution to the provision of adequate arms of offense;

b) The development of techniques in industry and the training of industry to use them effectively, whereby optimum output consistent with availability of plants, materials, man power and money will result;

c) The provision for procurement of adequate arms for defense from ABC attack, and from all attack which can be successfully opposed by means within the chemical realm;

d) Development of techniques for adequate production and skillful use skilled population of the nation, but attempting to draw therefrom, is limited by the ability of its own personnel to provide concepts fundamental to its objectives. A passive outside world of thinkers preoccupied with strictly commercial or educational purposes is not inspiring to the limit of its latent capacity.

A second plan for utilizing scientific resources might be to charge the birth of all new ideas for military application to non-military workers in the industrial and educational organizations. Lack of appreciation of military need would surely defeat this plan.

The third solution, which combines both of the two plans just proposed is the solution that most of us today agree is the productive way. A central military group charged with specific responsibility for weapons and plans, cooperating closely and actively with the far greater body of civilian scientific activity, not merely draws from them what incidentally may become available, but also encourages them and inspires them actively to take part, actively to contribute ideas and solutions of how to implement them. Your association becomes a most important part of this plan.

But it was not always thus. And we may again revert to the condition where the military withdraws into its shell of secrecy and deprives itself of this broad resource of scientific and industrial power. Between World Wars I and II we were frequently assured that the developing organic chemical industry in the United States was such that never again would we find ourselves with inadequate supplies of explosives and other chemicals essential for war. In part this was true, but we are still grateful for an intervening ocean and a British bulwark, which again protected us from attack until we could enlarge and mobilize our touted chemical potential. The two years between September 1, 1939 and December 7, 1941 gave us a priceless breathing spell, a time for preparation without which we may not have been able to prevail against our enemies.

During the interwar period our military establishment declined toward the vanishing point before it was painfully and slowly restored and augmented. The application of our industrial potential to defense awaited almost the beginning of the war in Europe. It has been said that seventy-five per cent of war production for World War II was placed under the management of twenty-five industrial firms. The ability of these supermanagements to meet the emergency is indeed a tribute to their skill and their willingness to place national needs above all other considerations. But was such a concentrated result the *best* possible utilization of our brain-power, our man power, materials and money that could have resulted from earlier planning and broader training of our manufacturing establishment?

Perhaps it took an actual attack by the enemy to disclose to us the important elements of blitz-warfare, but I believe our military knew beforehand, or could have known, the major means of defense and counterattack. Yet many of our most effective weapons had not yet reached pilot-production stage. There had been no widely applied system of educational production of the tremendous variety of material needed. Items regarded as obviously essential were still but a proverbial gleam in Uncle Sam's eye.

To illustrate: Detection and identification of poison gases for defense would seem obvious in chemical warfare, yet the M9 kit reached stabilized production in 1944 only after major specification changes had passed through the alphabet nearly twice—up to W-W — subsequent to actual placement of production orders in the fall of 1943!

Rapid mobilization of the chemical industry in event of war is paramount. The Armed Forces Chemical Association can perform no more important service to the nation than to urge and to keep on urging adherence to the declared program of research and development, piloting and educational production, which means such tremendous savings of time, money, materials and lives when emergency strikes. And this is not an expensive program. The overheads of government and industry alike are tremendous. Actual direct expenditures for research and development in themselves are comparatively small. Yet, to management they seem flexible, even dispensable.

Just now in the midst of a wave of military economy, there is tremendous pressure on government budgeteers to reduce direct expenses and yet maintain overhead. Perhaps this is true in part because the budgeteers are themselves overhead and feel themselves to be indispensable.

Now industrial overhead *must* be maintained if commerce is to continue —and we believe the military should serve the national economy, not absorb it. In reducing government expenditures the steps are too often: 1) restrict direct research and development expenses but keep overhead; 2) reduce or sacrifice both direct government expense and cooperative industrial expense; 3) finally only government overhead is left.

It is not far more profitable and less expensive to reduce overhead in government and to maintain to the last its program of direct expense including especially its co-operation with industry? Is it not better to rely upon industry to maintain its contribution of direct effort and overhead expense and thus to reduce to a minimum the combined burden before restricting the objective output of the system?

AFCA's HONOR ROLL

To reflect recognition and due credit upon commanding officers of Chemical units in the Organized Reserve Corps boasting 100% membership in the Armed Forces Chemical Association, AFCA will feature an Honor Roll in the JOURNAL listing the Reserve unit designation, location and commanding officer. Why Reservists should be members of AFCA may be found on page 19. Units qualified for the AFCA Honor Roll should be submitted by commanding officers to National Headquarters.

NEWS OF INDUSTRY

PERSONNEL ASSIGNMENTS

Ethyl Corporation

The appointment of B. Bynum Turner as general manager of manufacturing to assume charge of the company's activities in Baton Rouge, La., has been announced by Ethyl Corporation officials. In this capacity he will relieve John H. Schaefer, vice president and director, who returns to the New York office to direct all manufacturing operations from the company's headquarters.

Clinton W. Bond will continue as resident manager in charge of the plant at Baton Rouge. Mr. Turner, for the past two years, has been coordinator of the $40,000,000 plant expleted.

* * *

Pittsburgh Plate Glass

Appointment of Clarence J. Krueger as production manager for the paint division of Pittsburgh Plate Glass Company has been announced by E. D. Griffin, vice president.

Associated with the firm since 1927, Mr. Krueger has served as assistant divisional director of the Ditzler Color Division during the past three years. His first position with Pittsburgh's paint division was as a research chemist at the Milwaukee, Wisconsin plant.

* * *

Diamond Alkali Company

R. L. Wilson, manager of Raw Materials and by-products for Diamond Alkali, has announced the appointment of Milton L. Huemme as Manager of Coke Sales. He succeeds the late B. F. Lambert.

To his new post Huemme brings a background of 22 years' experience with Diamond, much of it in coke sales. He first joined the company's coke sales office in Cleveland as a sales and service representative in 1936, following nine years in raw materials supply work at the Diamond offices in Pittsburgh, Pa.

* * *

Hercules Powder Company

The following appointments have been announced by Hercules:

L. Coleman Hall, formerly plant superintendent, succeeds Charles A. Lambert, retired, as plant manager.

Frank W. Volk, formerly assistant plant superintendent, becomes plant superintendent.

Lyle W. Rothenberger, formerly technical assistant to Mr. Hall, becomes assistant plant superintendent.

* * *

American Cyanamid Company

Dr. Leslie Boatright, Purdue University; Dr. Paul F. Hopper, University of Notre Dame; and Dr. Donald J. Berets and Dr. George W. Kennerly, Harvard University, have joined the staff of the Research Division at the Stamford Research Laboratories. Walter H. Jura, University of Illinois, has joined the staff of the Analytical and Testing Division at Stamford Research Laboratories as well as Harold McDonough, a 1949 graduate of the University of Connecticut, who has joined the Chemotherapy Division.

CARBURIZING—HEAT-TREATING—AMERICAN CYANAMID

The Industrial Chemicals Division of American Cyanamid Company announces that new production facilities for carburizing and heat-treating compounds have been installed at the company's Kalamazoo, Michigan plant Cyanamid will continue to manufacture some of these compounds at its Warners Plant in Linden, N. J., but has added the new facilities in order to give efficient service to customers in the Midwest.

The recently completed facilities increase the Company's capacity for these products used by the Metal working industry, and have been designed so that a number of basic materials produced by the Company are utilized in production.

Among the products which will be produced in the new installation are Aeroheat, heat treating compound which is used as a salt bath for medium and high carbon steels; and Aerocarb Carburizing Compounds, which provide an economical and efficient method for the production of case depths to .100".

* * *

Rosin Chemistry Research

One of the more versatile products recently stemming from Hercules Powder Company's research in rosin chemistry, Rosin Amine D Acetate (called "RADA"), is being successfully used by the petroleum industry. A surface active organic amine salt in water soluble form, Rosin Amine D Acetate has also found applications in many other fields.

Rosin Amine D Acetate is being used in oil fields where the extraction of crude petroleum depends largely on secondary recovery methods, one of which is water injection.

This new chemical provides control of bacterial action and affords protection against corrosion of water-flooding systems. The reduction in corrosion and bacterial action aids in maintaining suitable water pressures required in the secondary recovery operation.

* * *

Rubber Utilization

Rubber chemists, who with their test tubes trail-blazed the way for the nation's synthetic rubber plants, are daily finding this man-made product a solution to problems in industries far afield from rubber according to H. R. Thies, manager of the Chemical Division of The Goodyear Tire and Rubber Company.

Not the least important of these is the paint industry, which for years has been diligently searching for an acceptable paint vehicle which would eliminate the use of expensive, and sometimes toxic, organic solvents and thinners. Thanks to a new paint making technology and the help of rubber research, water, itself now may be used successfully in high quality flat and semi-gloss finishes. According to Mr. Thies, this search seems to have culminated in the use of Chemigum or similar types of synthetic rubber latices. Displaying practically all of the properties needed in a good paint vehicle, these aqueous, rubber-like dispersions have been made into paints having tough, flexible films, superior in many respects to those used organic solvents and thinners.

AFCA'S

DRIVE FOR MEMBERSHIP IS ON!

By Fred M. Jacobs

Secretary-Treasurer
Armed Forces Chemical Association

The AFCA plaque represented on this page is about nine inches in height, eight inches in breadth and ready for hanging. The background is in natural wood color. The eagle is cobalt blue and the crossed retorts and AFCA lettering are in gold. The plate for inscription at the bottom is bronze.

You can have this plaque from your Association. Its award is authorized in recognition of exceptionally meritorious work, and it has been ruled that any member who enrolls ten new members has demonstrated such merit and is entitled to this award. There is no time limit, although the effort required should not take long. Already approximately 10 members have received or qualified for this award.

The enrolling of ten new members will not be an easy task, to be casually undertaken. It will be a difficult, time-consuming job, the successful accomplishment of which will warrant considerable pride and self-satisfaction. Winners of these plaques will have demonstrated ability, patriotism and self-sacrifice in performing a mission distinctly worthwhile; for increasing the membership of our Association adds to its strength and to its capacity for contributing to the cause of national defense.

New membership blanks are being issued, containing a space for the name of the applicant's sponsor, which will enable Headquarters to keep an accurate record of the progress of each eligible member. These application blanks, in addition to any other material, such as an additional supply of Journals and Directories, which you may require as an aid to your efforts will be forwarded promptly on request.

One of the most recent to enter the field of military associations (we are less than four years old), The Armed Forces Chemical Association is now generally recognized as one of the most aggressive, energetic and effective organizations in the country in the field of national defense.

The Armed Forces Chemical Association is growing rapidly. It is improving its service to chapters as well as unaffiliated members. Its Journal, News and Directory are the essence of sound editorial, technical and industrial informational material, covering the activities of all three Services. Members who may have dropped out after their first year of enrollment would scarcely recognize the great changes that have taken place in every aspect of the affairs of the Association. But that is not enough! Headquarters is cognizant of the fact that if we are to continue to grow, we cannot leave well enough alone.

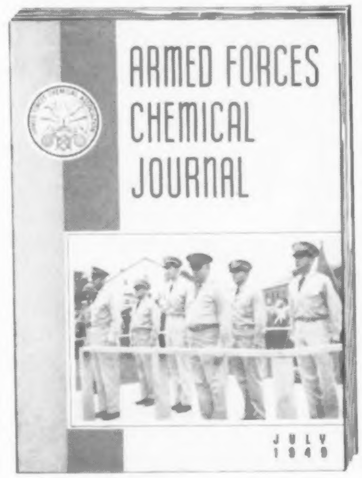
We have started the New Year with the determination to leave no stone unturned to make this the greatest year in our history in increased membership, as well as service to industry and members alike. Each member's standing will be duly recorded in succeeding publications.

We look to each of you, not only your officers and membership chairmen, but each individual member for help in accomplishing our goal. A determined effort—a few personal contacts or telephone calls—and the job is done!

AFCA'S PLAQUE

Ten Members — It's Yours

Please Send a FREE COPY of



to the following

As part of the invitation to join the Armed Forces Chemical Association and receive The Armed Forces Chemical Journal.

NAME ....
(PLEASE PRINT)

ADDRESS ....

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NAME ....

ADDRESS ....

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NAME ....

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NAME ....

ADDRESS ....

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NAME ....

ADDRESS ....

....

MY NAME ....

MY ADDRESS ....

....

In writing them, may we mention your name?

☐ Yes ☐ No

Many thanks to you.

CHEMICAL WARFARE*

DURING THE PERIOD 1931 TO 1949 TREMENDOUS ADVANCES WERE MADE IN THE FIELD OF CHEMICAL WARFARE. THESE GREAT SUCCESSES WERE DUE IN NO SMALL MEASURE TO THE APPLICATION OF THE PRINCIPLES OF COLLOID CHEMISTRY BY MILITARY AND CIVILIAN SCIENTISTS.

By Duncan MacRae
Technical Command

In 1931 Jerome Alexander (1) listed the principal chemical warfare materials substantially as follows:

War Gases: Mustard, Lewisite, Chloroacetophenone and Brombenzylcyanide.

Signaling Smokes: Red, "paratoner"; Yellow, "Chrysoidine plus auramine"; Blue "indigo"; Purple, "indulin"; and Green, "auramine plus indigo."

Screening Smokes: Phosphorus; sulfur trioxide (oleum); chlorsulfonic acid; tin, silicon, and titanium tetrachlorides; ammonium chloride; and zinc chloride (made by the interaction of zinc and carbon tetrachloride or hexachloroethane).

Irritant Smokes: Diphenylchlorarsine and Diphenylaminechlorarsine.

Incendiaries: At that time incendiaries and flame thrower fuels were held in so little esteem that they were not mentioned.

Weapons: Livens projector, 4-in. Stokes mortar, 4.2-in. chemical mortar and chemical artillery shell.

Gas Masks Components: Activated charcoal and aerosol filters. At that time Alexander pointed out that the colloid-chemical aspects of chemical warfare include the use of aerosols in the form of toxic, screening, and signalling smokes and that the principal functions of the gas mask are to filter out aerosols and absorb toxic vapors. Thus, at that time, a great part of the technique of chemical warfare was based on the principles of colloid chemistry.

It is the purpose of the present paper to indicate the important published contributions of colloid chemistry to chemical warfare in the period from 1931 to 1949. During this period tremendous advances in the field of chemical warfare were made. War gases, including irritant smokes, were used to a comparatively small extent by the Italians in Abyssinia (7). Signalling smokes found important uses in combat and were widely used (4a). Screening smokes were used on a scale never dreamed of before in operations in both Europe and the Pacific (4b). They were of great value in connection with landing operations, they greatly reduced losses in loading and unloading supplies at the docks, and were effective in preventing the success of Kamikaze attacks by Japanese aviators (4h). The war economy of Japan had already been wrecked by incendiaries two months before its surrender (4f), and flame throwers greatly accelerated the advance of MacArthur's troops northward by overcoming very effective resistance by the Japanese fortifications of the bunker type. (4g). These great successes in chemical warfare were due in no small measure to the application of the principles of colloid chemistry by military and civilian scientists. The new chemical warfare materials and related developments in colloid chemistry are discussed below.

War Gases

In the field of war gases, the following compounds, not included in the 1931 list, have been mentioned in authoritative publications (2, 4d) as substances considered in preparations for gas warfare:

Nitrogen mustards: $N(C_2H_4Cl)_3$

Fluoroacetates: $CH_2FCOOCH_3$ and $CH_2FCOONa$

Diisopropyl fluorophosphate: $(i\text{-}PrO)_2POF$

In addition to these, the two war gases, hydrocyanic acid and cyanogen chloride, which had seen some use in World War I, were perfected for use in World War II.

These compounds and other war gases are of interest to colloid chemists on account of their chemical action on the colloidal components of living organisms.

It has been found that tris (beta chloroethyl) amine undergoes cyclization in aqueous solution to form the quaternary imonium compound $(ClC_2H_4)_2C_2H_4N^+Cl^-$. The following is quoted from Chapter XXXVI of Advances in Military Medicine (2):

"Whereas the original tertiary amine is a relatively nonreactive product and, indeed, except for the property of cyclization may be said to be chemically inert, the quaternary imonium compound with its ethylenimonium ring is one of the most reactive of organic chemicals. So reactive is it that reaction occurs readily even with water, in the following manner:

$$\begin{array}{l} CH_2CH_2 \\ {}^+N\ CH_2CH_2Cl + H_2O \\ CH_2CH_2Cl \end{array} \longrightarrow \begin{array}{l} CH_2CH_2OH \\ N\text{-}CH_2CH_2Cl + H^+ \\ CH_2CH_2Cl \end{array}$$

If substances other than water are present they can react competitively. So reactive are some compounds that in their presence reaction with water is negligible. As examples of compounds of biologic importance that readily react with the ethylenimonium ring of the nitrogen mustards may be mentioned the a-amino, imidazole, sulfide, phenolic, (E-amino, and imino groups of amino acids and peptides; inorganic phosphate, as well as glycerophosphate and hexose phosphates; the amino groups of adenosine and thiamine; and the pyridino-N of nicotinic acid amide and pyridoxine. In addition, reactions have been demonstrated to occur with proteins such as hemoglobin, insulin, gelatin, crystalline egg albumin, tobacco mosaic virus, ovalbumin, and protamine, as well as various purified enzymes. Thus it appears likely that the basis of the systemic toxicity of the nitrogen mustards resides in the high chemical reactivity of the ethylenimonium ring.

"The information afforded the chemists by the nitrogen mustards was the necessary tool for the elucidation of the chemistry of the sulfur mustards. Thus, in aqueous solutions sulfur mustard readily forms a sulfonium ring as follows:

$$\begin{array}{l} CH_2CH_2Cl \\ S \\ CH_2CH_2Cl \end{array} \longrightarrow \begin{array}{l} CH_2CH_2 \\ S \quad + Cl^- \\ CH_2CH_2Cl \end{array}$$

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The ethylenesulfonium ring is even more reactive than the ethylenimonium."

In searching for the explanation of the basic mechanism of action of the fluoroacetates, attention was directed to their effects on the intermediary metabolism of carbohydrates. It was suggested that their specific action was to block the oxidation of acetate itself by competitive inhibition of the enzyme systems on which the utilization of acetate is dependent.

While no fluoroacetate qualified as a war gas, sodium fluoroacetate was an outstanding success as a pesticide (2a).

Reports indicating that quantities of an alkyl derivative of fluorophosphoric acid had been prepared in Germany led to the preparation of diisopropyl fluorophosphate in England. It has the property of reducing cholinesterase activity. It has been shown that rabbit and human serum, red cells and tissues, especially those of the liver, contain an enzyme that accelerates decomposition of fluorophosphates (2d).

The two war gases, hydrocyanic acid and cyanogen chloride, which had seen some use in World War I, were perfected for effective use in the field (4d). The classical observation that methemoglobin can combine with and thus effectively remove cyanide from its combination with cytochrome oxidase was amply confirmed (2b).

The study of the mechanism of action of Lewisite led to the discovery that a certain chemical compound could be used effectively in preventing injury by vesicant arsenicals. That compound is 2, 3-dimercaptopropanol and is known as BAL (British Anti-Lewisite). When the skin or eye of an animal had been contaminated with Lewisite, the application of an ointment containing BAL was very effective in minimizing the damage. The mechanism of its action is believed to be due to the fact that the -SH groups of BAL compete for the arsenic that would otherwise combine with similar groups in body proteins (2e).

Screening Smokes

The principal addition to the list of screening smokes since 1931 is fog oil, a high-boiling petroleum fraction (6a). Its success was due to the applications of the principles of colloid chemistry. With the aid of the Mie theory of light scattering (P-7) it was possible to determine the proper size of particle to give the maximum scattering in the region of visible light. For materials of refractive index of 1.5 this is a particle with a diameter of 0.6 micron. That theory was also useful in the development of apparatus for the rapid determination of particle size (P-7). The conditions required for the production of a fog oil aerosol with particles of this size were worked out in the laboratory and smoke generators designed and constructed to produce them. In some generators the oil was vaporized and the vapor allowed to escape through small nozzles into air. The size of the particle depended on the linear velocity of the vapor and the rate of cooling. These in turn were dependent on the rate of heating of the oil and the dimensions of the nozzles (6a). In other generators a venturi throat was used for atomizing and mixing the oil with hot gases. Obviously the oil must have such vapor pressures as would permit it to be vaporized at a practicable temperature and yet be condensed into an aerosol at air temperatures prevalent in the field. Nor must it decompose excessively during the process of vaporization.

Theories relating to the rise and spread of aerosol clouds combined with knowledge of their ability to scatter light were useful in describing the field behavior of smoke screens. For example, when viewed from above, a smoke cloud from a single generator frequently has roughly the shape of a cigar. The length at the center line is obtained from the following equation:

$$X_{max} = \left[\frac{Q}{\sqrt{\Pi}\, C_y U N_o} \right]^{\frac{2}{2-n}}$$

The maximum half-width is given by the following:

$$Y_{max} = 0.248 \quad \frac{Q}{UN_o}$$

and

$$X \text{ (at max. y)} = (0.606) \; X_{max}$$

in which (P-8)

Q = the source strength, g./sec.

C_y = the turbulent diffusion coefficient in the crosswind direction

U = the mean wind velocity, m./sec.

N_o = the minimum density for screening, g./sq.m.

n = a number between 1 and 2 whose magnitude depends on atmospheric turbulence.

Colored Signal Smokes

The following dyes have been found to produce satisfactory colored smoke clouds (P-4):

Dye	Type	Color of Smoke
Auramine	Diphenylmethane	Yellow
B-Naphthaleneazodimethylaniline	Azo	Yellow
Benzeneazodimethylaniline	Azo	Yellow
1-Methylaminoanthraquinone	Anthraquinone	Red
9-Diethylaminorosindone	Azine	Red
a-Aminoanthraquinone(a)	Anthraquinone	Orange
1-Amino-8-chloroanthraquinone(a)	Anthraquinone	Orange
Quinizarin	Anthraquinone	Orange
1,4-Diaminoanthraquinone(b)	Anthraquinone	Violet
1,4-Diamino-2-3-dihydroanthraquinone(b)	Anthraquinone	Violet
1,5-Di-p-toluidinoanthraquinone	Anthraquinone	Violet
1,8-Di-p-toluidinoanthraquinone	Anthraquinone	Violet
1,4-Di-p-toluidinoanthraquinone(a)	Anthraquinone	Green
1,4-Dimethylaminoanthraquinone	Anthraquinone	Blue
1-Hydroxy-4-p-toluidinoanthraquinone	Anthraquinone	Deep Blue

Note: (a) Mixed with auramine for proper shade.
(b) Mixed with 1-methylaminoanthraquinone for proper shade.

The successful use of these smoke clouds evidently depends on much the same principles as that of the screening smokes. The theory of best particle size for colored smoke does not seem to be so well known.

Incendiaries

A widely used incendiary consisted of magnesium made into special bombs and clusters, and an even better incendiary involving the application of colloid science—the gelled gasolines (P-3). In England it was found that gasolines gelled with rubber were a very effective incendiary for use in bombs because it was not dispersed into small particles by the burster charge, but rather in pieces weighing about half a pound, which proved to be very effective in setting fires. Due to the scarcity of rubber, thickening materials were developed in the United States to replace rubber. The best known of these was a mixture of aluminum naphthenate and palmitate called Napalm.

This material was not only effective for use in incendiary and fire bombs, but proved to be of great value when mixed with gasoline for use in flame throwers. Its high viscosity greatly increased the range of the flame thrower and its thixotropic properties (P-1) made this possible with a minimum of pressure required to force the thickened gasoline through the hose and flame thrower nozzle.

Weapons

In the recent war neither the Livens projector or the 4-in. Stokes mortar were used. The 4.2-in. chemical mortar (4e) became one of the most effective weapons in support of infantry. Its range was increased to between 4,000 and 6,000 yards, and the fillings for its shell included not only phosphorus, to produce screening smokes, and colored

smokes, for signalling purposes, but also high explosives. The only chemical warfare materials used in artillery shell were screening smokes and some colored smokes. Other important weapons used in World War II but not mentioned in the 1931 article are gas, smoke and incendiary bombs, flame throwers, grenades, smokes, generators and smoke pots. These are of little interest to colloid chemists aside from the materials used in them.

Gas Masks

The gas masks of World War II were quite different in many respects from those used in combat 25 years earlier. They were lighter and of different shape but the adsorption of vapors and the filtration of aerosols still played the major parts in their method of functioning.

The study of the mechanism of the filtration of aerosols during the period covered by the present paper, resulted in vastly superior filters in the German gas masks. These were duplicated and improved in the American and British mask.

The principles of canister design relating to the use of charcoal to adsorb gases were greatly elaborated, and greatly improved charcoals were available compared with those available in 1931. The result of this is seen in the much smaller and lighter gas mask canisters which are available in modern gas masks.

Corresponding improvements were made in collective protectors for the purification of large volumes of air.

Gas Mask Charcoal

It was known prior to 1931 that the performance of a bed of charcoal in removing a vapor from an air stream by adsorption could be represented simply by an equation substantially equivalent to the following (P-9):

$$C_0QT = N_0A \ (X\text{-}I) \qquad (1)$$

in which

C_0 = concentration of toxic gas in air stream at entrance face of bed

Q = rate of flow in volume per unit time

t = time

N_0 = saturation capacity of a unit gross volume of adsorbent for the (toxic) gas

A = cross-section of adsorbent bed

x = thickness of bed

I = critical bed depth, i.e., the actual intercept of a life-thickness curve on the thickness axis.

When $I=O$, that equation states that C_0QT, the weight of vapor adsorbed, is equal to N_0AX, that required to completely saturate the bed. This is nearly true for the process of adsorbing the vapor of a high-boiling liquid from dry air at very small rates of flow; but for useful flow rates, I has appreciable values and plays an important part in the design of gas mask canisters.

Of the variables contained in equation (1) the colloid chemist is primarily interested in the saturation value N_0 and the constant I.

The saturation value N_0 is a property of the charcoal which depends on the test concentration, C_0. It varies with that concentration and can be read from an adsorption isotherm. One of the principal problems in gas mask development is to provide charcoals with high values of N_0 for all toxic gases. In testing charcoals an important problem is to select a test gas and test conditions which will permit conclusions to be drawn as to the general serviceability of the charcoal in adsorbing all vapors. It has been known that N_0, expressed in volumes of liquid per unit volume of adsorbent bed, for many charcoals is nearly the same for all vapors at high relative pressures. (Sometimes, however, some of the charcoal capillaries are so small that substances with large molecules cannot enter them and therefore have smaller values of N_0 than do substances with smaller molecules). At lower relative pressures the adsorption isotherms of different substances on the same charcoal diverge widely. Recently progress has been made in estimating unknown adsorption isotherms from one that is known (P-10, P-11). In general, substances highly associated in liquid form are much less readily adsorbed by charcoal than are non-associated ones at the same relative pressure (P-12).

Gas mask charcoals not only serve to adsorb vapors, but also support certain chemical substances which react with certain gases or serve to catalyze their reaction with water vapor or oxygen. Thus copper oxide has long been used to catalyze the oxidation of arsine. Its performance in this respect is improved by the presence of a small amount of silver salt (6b). Copper oxide also reacts with hydrocyanic acid to form cuprous cyanide and cyanogen (6c). Further, it reacts with hydrogen chloride formed by the hydrolysis of phosgene. The removal of cyanogen chloride is aided by the presence of pyridine or chromium salts. Many other impregnants are also used to aid in the removal of these and other gases. In some of these cases a value of N_0 may be calculated from the amount of the substance which will react with one of the impregnants present. In others the processes are much more complicated than simple adsorption and there does not appear to be any well defined value of N_0 for the substance in question.

While N_0 is the absorption capacity of the charcoal at equilibrium, the constant I is related on the rate of adsorption. For most charcoal beds it is possible by varying the thickness of the bed to find a value such that the break concentration appears at the instant the test gas reaches the effluent side of the charcoal bed. That thickness is such that the test concentration, C_0, is reduced to the break concentration, C_e, in the time required for a point in the air stream to traverse the bed.

As the air stream flows through the irregular passages in the bed, the molecule of vapor diffuses out of the air stream through the thin film of stationary air that surrounds each charcoal particle, strikes the solid particles and either stick or rebound. If it does not rebound into the gas film, it may or may not reevaporate, react with another molecule, or move over the surface. Even if every molecule that strikes the charcoal sticks and does not reevaporate later, it still takes a finite bed thickness to reduce the concentration from C_0 to C_e. Under these conditions

$$I = I_t = H_t \ln C_0/C_e \qquad (2)$$

in which H_t is the thickness at which $C_e = C_0/2.72$. H_t is what chemical engineers call the height of a transfer unit. For a bed packed with irregular particles it has been found by experiment that

$$H_t = K\ D_p\ (D_pPV/M)^{0.41}\ (M/PD_v)^{0.67} \qquad (3)$$

Thus H_t depends on the particle diameter D_p, the linear air velocity, V, and of the molecular diffusion coefficient of the test gas, D_v, and of the viscosity and density of air, M and P respectively (P-9).

So calculated, I_t is a lower limit of I based on the assumption that every molecule of test gas that hits the charcoal granules sticks and does not rebound or reevaporate later. (For in that case the concentration of test gas at the surface of the charcoal particle is zero.) This lower limit can be reduced by reducing the size of the charcoal granules, by reducing the rate of flow of the air stream or by using a test gas with a larger diffusion

coefficient; but once the critical bed depth has reached this lower limit, it cannot be further reduced by any change in the interior structure of the charcoal or in the nature of its inner surfaces.

The critical bed depth has been found to be substantially equal to I_r in the case of chloropicrin and a well activated charcoal; but in the case of the adsorption of water vapor by charcoal, the critical bed depth may be much greater than I_r. This is due to the fact that at low relative pressures (i.e. relative humidities in the case of water) well activated charcoal adsorbs little, if any, water vapor. Consequently a large fraction of the number of molecules that strike the charcoal surface in a given time must either rebound or quickly reevaporate. It may be even that under certain conditions all water molecules rebound or quickly reevaporate. Unless some adsorption takes place at C_o, I may be infinite.

It is evident from the above that in general

$$I = I_i + I_r \tag{4}$$

in which I_i is that part of the critical bed depth due to diffusion in the air stream and I_r is that part due to processes taking place in or on the surface of the granules.

Not only has the theory of the performance of gas mask charcoal been extended; but progress has also been made in the practice of carbonizing suitable raw materials and activating the charcoal so obtained (P-6).

Thus the design and performance of that essential Chemical warfare item, the gas mask, depends to a large extent on a knowledge of the adsorption isotherm and of the kinetics of adsorption and desorption.

Gas Mask Filters

Toxic smokes were used in combat in World War I to penetrate the gas masks in use at that time. It then became necessary to add aerosol filters to the gas mask canisters in addition to the charcoal already provided in them to remove toxic gases or vapors. The operation of these filters may be best understood if we first understand how aerosols penetrate a charcoal bed.

If we consider aerosol particles to be very large molecules, then a number of these particles with their Brownian motion in air constitute the vapor of a substance with a very high molecular weight. Such a substance would have a very low vapor pressure and once one of its molecules (aerosol particles) collided with a solid surface, it would stick to it and not reevaporate. This fact alone would tend to make aerosols less capable of penetrating charcoal beds than are vapor molecules. On the other hand, a vapor with such large molecules would have a much smaller diffusion coefficient than ordinary molecules. It is therefore evident from equations (2) and (3) above that other things being equal, the critical bed depth would be greater for aerosols than for vapors.

Elsewhere (P-13), it has been calculated that the diffusion coefficient of an aerosol composed of particles 0.302 microns in diameter, is $1.08\text{x}10^{-6}$ cm²/sec. as compared with 0.088 cm²/sec. for chloropicrin. Consequently, if the critical bed depth under certain conditions were 0.1 cm. for chloropicrin, it would be

$$I = 0.1 \text{ cm. x } (0.088/1.08 \text{ x } 10^{-6})^{2/3} = 190 \text{ cm.}$$

It is evident that this value is much larger than would be practicable for use in any military gas mask. Consequently, existing gas masks would be penetrated at once by the aerosol. Or, viewed in another way, if the penetration of the charcoal bed by chloropicrin were 10^{-10}, that for the aerosol in question would be the number whose logarithm is $(-10) \text{ x } (1.08 \text{ x } 10^{-6}/0.088)^{2/3} = -0.0056$. This corresponds to a penetration of about 98% by the aerosol.

Equations (2) and (3) thus give an idea of the variables which affect the filtration of aerosols. However, there is more to the subject than this. For example, increase in the size of the aerosol particles leads to smaller diffusion coefficients and greater penetration; but it is not to be expected that this will continue indefinitely. As the particles increase in size they will be screened out mechanically or will be thrown out by their inertia when they suddenly change direction in the irregular passages of the filter.

The filters used in World War II were a great improvement over the filters available in 1931; but they still consisted largely of fibers. It was found that for a filter to give good protection against small particles, the fiber diameters should be approximately equal to those of the particles removed. Many fine fibers, notably those of asbestos, are used in aerosol filters (6d).

An important contribution to the problem of filter development and test was the development of instruments for rapidly determining the size and concentration of the particles of the aerosol used in testing experimental and production filters (6e).

Conclusion

In the period covered by the present paper, colloid chemistry has contributed greatly to chemical warfare. On the other hand, chemical warfare problems have greatly stimulated research in the field of colloid chemistry and papers resulting from that work are still appearing in the scientific literature.

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★ WE'VE BEEN ASKED ★

Does time in grade of terminal leave promotion and time on short tours of active duty affect the date of rank of an individual who has returned to extended active duty in the grade he or she held prior to separation?

The National Defense Act provides that date of rank for Reserve Officers is established by serving on active duty. Thus, an individual who received a promotion prior to the end of his terminal leave most certainly counts the active duty served during terminal leave for date of rank. Also, any tours of active duty for training purposes are used to establish date of rank.

* * *

I am a reserve officer, serving on active duty in the grade of Captain, AUS. In June, 1947 I made application for a commission in the grade of Major. Subsequently I received a letter dated 19 June 1947 appointing me a Major in the ORC effective 19 June 1947. I executed the Oath of Office on or about 15 July 1947 and returned it to the issuing headquarters. Subsequently I received a commission indicating that my appointment would date from 19 June 1947, the same date that appears on the appointment letter. My immediate headquarters informs me that my appointment does not date from 19 June 1947 but from date of acceptance, on or about 15 July 1947. Is this correct?

Your appointment dates from the day of acceptance, i.e. 15 July 1947. However, for promotion purposes in counting time in grade your promotion will be based from the date of your commission. Your date of rank will be based on date of acceptance and as you know, date of rank is established by active duty in grade.

* * *

Can an officer who has completed 20 years active commissioned service secure a commission in the Honorary Reserve? Also, can he then qualify for retirement at age 60?

Yes, to both questions.

* * *

What is meant by presumptive service-connection?

There is a provision in the law to presume service-connection for specified disabilities that become manifest within stated periods of time following separation from active service.

What is the difference between a mobilization assignment and a mobilization designation?

A mobilization assignment is duty to which an individual is assigned in anticipation of war or other national emergency. Moblization assignments are assignments to ORC table of distribution units or augmentation thereto, or to ORC table of organization and equipment units. A mobilization designation is the selection of an individual to fill an authorized position vacancy upon mobilization in a Regular Army T/O & E augmentation. T/O & E augmentation—the spaces authorized and considered necessary to reinforce existing Regular Army T/O & E units.

The best resolution you can make for 1950 is to resolve yourself as an independent Membership Chairman for the Armed Forces Chemical Association. National Headquarters is ready, willing and able to handle as many new members as you are capable of enlisting and forwarding to Headquarters.

It has been brought to my attention that under U.S. Code Title 37, Section 115 provides that any officer of the armed services on active duty as of 12 November 1918 is entitled upon retirement for any honorable cause a payment of 75% of his highest rank. Does this apply to Reserve Officers?

The law to which you refer is applicable to Regular officers. However, by Army Regulations, under the provisions of Title II, Public Law 810, this law is applicable to any Reserve Officer who has a total of 20 years active Federal service, ten years of which have been commissioned service. In other words, an individual to qualify would have served on active duty in the Army or Air Force for a total of 20 years, otherwise he could not receive benefits under this particular law.

Could you advise me if HR 5508, providing that members of the Reserve be awarded a year of satisfactory service from the period June 28, 1948, to June 29, 1949, was ever passed by the Senate an dis now law?

HR 5508 was enacted into law, and the cut- off date for the accumulation of points for retirement is as of July 1, 1949, instead of June BT, VTDR.

* * *

I went on active duty in September 1940 and was retired for physical disability in November 1945 and subsequently awarded a 40% disability ratingb y the Veterans Administration. Will the new pay bill alter my disability income?

Under the provisions of the retirement section of the new pay bill, Reserve Officers retired for physical disability and who are presently receiving retired pay can continue to receive 70% of their base and longevity pay under the old pay scale, or they may elect to go before a board for a rating and come under the provisions of the new pay bill in accordance with the rating given them. Officers rated 75% or more disabled will receive 70 percent of the base and longevity pay of the new pay bill. Those rated 30% will receive 30% of the base and longevity pay of the new pay bill.

* * *

I am a member of the Army Active Reserve and draw disability compensation. Is it possible for me to receive points through inactive duty training for retirement under PL 810?

Yes, as long as you hold an Active Reserve commission and participate in inactive duty training. However, when you reach age 60 you must choose between receiving disability compensation and reserve retirement pay.

* * *

Is an AUS (ORC) officer in a retired status entitled to Veterans Administration hospital observation and treatment for ailments other than those for which he was retired?

Yes.

* * *

Does admission to an Army or VA hospital affect the retired status of an AUS officer under treatment?

Not if he has a wife and/or dependents. However, if he is a bachelor, Public Law 662 of the 79th Congress provides that there will be no reduction in his pay during the first six months in the hospital but starting with the seventh month his payments will be reduced 50% each month and held for him until he is dismissed from the hospital, at which time he will receive the full amount of the deductions in one payment.

BOOK REVIEWS

By L. Wilson Greene

ELECTRONIC INTERPRETATIONS OF ORGANIC CHEMISTRY. A Edward Remick. vi+600 pages. Second Edition. New York: John Wiley & Sons, Inc. 1949. $6.00.

The many advances in this phase of organic chemistry since the appearance of the first edition of Dr. Remick's book six years ago have prompted him to revise his text completely. Nearly 100 new pages have been added, including a new chapter on stereochemistry. The book is divided into the following twelve chapters: Pre-Electronic Theories of Chemical Affinity, Early Applications of the Electron Theory to Problems of Organic Reactivity, Applications of the Lewis Theory to Problems of Molecular Structure, The Generalized Concept of Oxidation-Reduction, Outline of the Electronic Theory of the English School, Some Contributions from the Field of Chemical Physics, Some Contributions from the Field of Kinetics, The Role of the Solvent, Some Contributions from the Field of Stereochemistry, Electron-Sharing Reactions, Electron-Pairing Reactions, and Some Contributions from the Field of Electrochemistry. One feature of the book that will appeal to many chemists is the emphasis placed throughout on the practical applications of these theoretical principles to the problems of organic chemistry.

OUTLINES OF BIOCHEMISTRY. Ross Aiken Gortner. xvi+1078 pages. Third Edition, edited by Ross Aiken Gortner, Jr., and Willis Alway Gortner. New York: John Wiley & Sons, Inc. 1949. $7.50.

Those familiar with the literature of biochemistry need no introduction to the work of the late Professor Gortner in this field, nor to this standard reference work which first appeared 20 years ago and was revised eight years later. His two sons, aided by eight collaborators, undertook to bring it up-to-date just about the time that World War II was getting under way. The revision was delayed for several years and completion of parts of the book was interrupted by other demands on the editors' time since the war. That probably explains a criticism in a contemporary review that there are very few references to the literature from 1946 onward. Some sections of the book do cover the literature through 1947 and there are a few 1948 references, especially in the chapters devoted to vitamines, hormones, and enzymes. Perhaps those who expect the book to reflect a complete up-to-date literature survey will find it disappointing, but for most of us who want a well-written treatise on the whole complex field of biochemistry will be content with this latest edition of Gortner. Incidentally, the typography and binding of this volume are typical of the excellence we have come to expect of Wiley books.

AFCA BULLETIN BOARD

An Industrial Employment Review Board to pass on appeals from decisions which deny to military contractors or their employees access to classified military information has been established by Secretary of Defense Louis Johnson.

The new Board will consist of four members—a chairman designated by the Munitions Board, and one member each to be designated by the Secretaries of the Army, Navy, and Air Force. The Munitions Board has named Mr. John T. Mason, a consultant on production matters, to be the chairman.

The Industrial Employment Review Board is the appeals group of the Department of Defense organization for military security in industrial matters which includes the Joint Personnel Security Board. The Industrial Employment Review Board will take over the functions of the review board which has been operated in the Office of the Provost Marshal General of the Army.

The new Board's charter provides that at least one of the four members will be a lawyer with membership in a State bar association or its equivalent, and that the lawyer member shall participate in any Board action which affects the actual disposition of an appellant's case. The Army initially will provide the lawyer member of the Board.

Military contractors or individual employees denied access to classified military information by action of the Personnel Security Board or field agencies of the three military departments having similar jurisdiction may, within 30 days of the denial, appeal to the Industrial Employment Review Board. The Board may establish area or regional Boards.

The Industrial Employment Review Board's charter provides that it will (1) entertain all appeals within its jurisdiction, and give to the appellant reasonable notice of the time and place of hearing; (2) provide the appellant with a specific statement of charges insofar as consideration of security permits; (3) afford the appellant an opportunity to be heard in person or by counsel (union representative or otherwise), and to cross examine Government witnesses who may be called to testify; (4) accept evidence or other proof offered by the appellant bearing on the issues to be determined by the Board; (5) furnish the appellant, upon his request a verbatim transcript of the Board's proceedings in his case, edited only to the extent necessary to safeguard information classified confidential or higher; (6) decide each appeal upon all of the information available to the Board, in accordance with criteria approved by the Secretaries of the Army, Navy, and Air Force; (7) set forth its decision in writing and furnish a copy of the decision to the appellant.

In the case of military contractors, access to classified military information will be denied if (1) any of the personnel of the contractor or prospective contractor is ineligible for access to information or material under the criteria specified for individuals; (2) if the contractor or prospective contractor is under the control or influence of foreign interests under circumstances which may jeopardize the security interests of the United States.

AFCA BOOK REVIEWS

RADIOACTIVE MEASUREMENTS WITH NUCLEAR EMULSIONS. Herman Yagoda. ix/356 pages. John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., London, 1949. $5.00.

Your reviewer's first impression on examining this book was to be somewhat astonished by the amount of information that has been accumulated on the use of photographic emulsions for measuring radioactivity. Even though Moser observed in 1842 that a number of substances, such as chalk, marble, cotton, and feathers, affect silver halide emulsions in the dark to produce a developable image, and Becquerel carried out his classical work with uranyl sulfate in 1896, most of the really useful developments in this field are comparatively modern. Dr. Yagoda, who is Senior Physical Chemist of the National Institute of Health, is, as the publisher says, "one of the comparatively few men in the United States qualified to write a definitive book on the use of the photographic emulsions in the field of radioactivity." He has presented his subject under the following chapter headings: Photographic Dtection of Nuclear Particles, Comparisons of Scintillation and Photographic Methods, Laboratory Manipulations, Alpha-Particle Patterns on Nuclear Emulsions, Quantitative Aspects of the Alpha-Particle Pattern, Radiochemical Studies with Nuclear Emulsions, Alpha-Particle Patterns of Uranium and Thorium Minerals, Alpha Tracers in Crystallography and Metallurgy, Biological Applications of Alpha Particle Tracers, Principles of Beta-Particle Autoradiography, Applications of Beta-Ray Patterns, and Applications in Nuclear Physics. The text is followed by a bibliography of over 650 references, data on range-energy relations in Ilford nuclear research emulsions, and a table of atomic constants and conversion factors. The text is illustrated by 75 photographs, sketches, and charts, and there are 31 tables of data. No scientist who wishes to keep abreast of developments in this Atomic Age should be without Dr. Yagoda's excellent book.

* * *

BIOCHEMICAL PREPARATIONS. Vol. 1, Herbert E. Carter, Editor-in-Chief. xi/76 pages. John Wiley & Sons, Inc., New York, 1949. $2.50.

This volume is the first in a series designed to provide authoritative and thoroughly checked procedures for the preparation of substances used in biochemical research. The editors hope that this series will aid bio-chemistry in the same manner that the *Organic Syntheses* series has helped to advance organic chemistry. The preparation of the following substances is described in the present volume: adenosine diphosphate, adenosine triphosphate, L-alanine and L-serine, azobenzene-p-sulfonic acid trihydrate, phydroxyazobenzene-p-sulfonic acid, 5-nitronaphthalene-1-sulfonic acid dihydrate, casein, B-3,4-dihydroxyphenyl-L-alanine, diphosphopyridine nucleotide, the A-glucose-1-phosphates, L-glutamine, DL-glyceraldehyde 2-phosphoric acid, lycopene, L-lysine monohydrochloride, lysozyme, and D-tyrosene. A new volume in the series is promised for every 12 to 16 months.

L. WILSON GREENE

DUPONT IN WORLD WAR II

(Continued from page 5)

plutonium was in existence—it would have required more than 28,000 milligrams to make up a single ounce—and there was decidedly limited familiarity with its properties.

"The task imposed wholly new problems. There were no precedents, no guideposts, no history. New equipment, much of its extraordinary complex, was required; vital experimentation and development had to be compressed within the limits of an exacting schedule.

"Unique in conception, huge in scale, the entire Hanford project placed upon the company and the employees engaged in the work an assignment of peculiar and formidable proportions. It is a satisfaction to report that it has fulfilled the government's hopes fully."

At Hanford, 45,000 were employed on construction alone. The work involved was the use of 8,500 large pieces of construction equipment, the building of 345 miles of permanent roads and 125 miles of railroad. Twenty-five million cubic yards of earth were excavated and 780,000 cubic yards of concrete were placed, along with 1,500,000 concrete blocks, 750,000 cement bricks, and 40,000 tons of steel, to mention only major items.

The project cost the United States $350,000,000. In an official statement to the press, the War Department called it "the epic of American industry's and the American workers' answer to the challenge of a great emergency."

The profit paid the Du Pont Company was the fee of $1.00, fixed by Du Pont itself. Moreover, the company insisted on turning over to the government all rights to patents growing out of its work.

How did Du Pont make out profitwise on the war as a whole? The company's annual report for 1945 contained small reason for rejoicing by stockholders, except for what comfort they may find in the caliber of the job done. Average earnings and dividends per share of Du Pont common stock, during the four-year period following the entry of the United States into the war, compare with the average earnings and dividends of the three preceding years as follows:

	1939-1941	**1942-1945**
Earnings	$7.45	$5.89
Dividends	7.00	4.75

The differences are 21% less in earnings and 32% less in cash that the stockholders actually received for the war years.

The report shows three other interesting facts:

1. During the last three years of the war, production was more than doubled in Du Pont-owned chemical plants as compared to the 1939 volume of those plants.

2. Du Pont employees during World War II suffered only one-tenth as many time-losing accidents, per million of man-hours worked, as did the workers in all U. S. industry.

3. The average of Du Pont sales prices was 4% lower at the end of 1945 than in 1939, although the companys tax bill increased 136% and the cost of its principal raw materials advanced 46% in the same period.

SCIENCE IN DEFENSE

(Continued from page 12)

13. Light, high-capacity stream-crossing equipment.

14. Improved construction equipment and materials for airfield and road building.

15. Mine detection equipment for location of all known types of mines and mine-clearing equipment.

16. Individual and collective protective equipment against all known toxic agents including detecting devices.

17. Effective prophylaxis and treatment methods and agents for epidemical diseases and cold injuries.

18. Improved field medical equipment, smaller, lighter, and suitable for transport by air.

The Army needs help in solving many problems that reach far beyond the military, but nevertheless have a direct bearing on the outcome of total war; such as psychological and propaganda warfare being studied by our General Research Program, the various aspects of our artic program designed to enable us to protect our northernmost boundaries, the weather and how it can be adapted to suit our purposes and not those of the enemy, the problem of our diminishing natural resources and scarcity of strategic materials with which to produce the weapons of war, and finally, better means of collecting and disseminating scientific information to avoid duplication of effort and produce speedier results.

Our supremacy, our superiority in all fields of military endeavor—our power—our peace, in this world of growing scientific values, depends in large measure on scientists. We must establish our peace through the *quality* of our efforts, through the *quality* of our weapons, through the *quality* of our thinking, our planning and our *fighting!* And all of these things will depend upon the *quality* of our technological and scientific "know-how." It is up to the Reserve Officer to make our Organized Reserve Corps Research and Development Program a success—and beyond that, to help make our search for a permanent and lasting peace, establish in the only possible way—through adequate National security—a living reality, so that we may continue to *live* in this world which is daily improved by Science. Then, having established our *safety* through science, we may establish our happiness, our health, our improved living standards — through *Science!*

STOCKPILING

(Continued from page 22)

able us to deal promptly with shortages of materials that would otherwise hamper top priority programs. Thus it will speed our industrial mobilization when every week saved may mean the saving of thousands of lives and billions of dollars.

The stockpile rounds out our whole national security program, to make this nation as strong as possible in all the elements needed in war. To serve warning to any would-be aggressor that the United States is amply prepared to defend itself from attack and, if necessary, to back up with force its international responsibilities. It is our devout hope that this preparedness will contribute much to the keeping of the peace.

In short, the completed stockpile will be a paid-up insurance policy. It will have a cash surrender value that is not far from its cost. As long as we hold it, it will contribute visibly to our national security. And if it is ever used in war, it will save this country manpower, time, dollars, and most of all, lives.

— WE'VE BEEN ASKED —

When at age 60 an officer is eligible to start drawing his military pension under PL 810 and is still an active civil service employee, can he draw both pension and salary or does he have to waive his military return as long as he is drawing a civil service salary?

One may not draw active pay from the Government and Reserve retired pay at the same time. However, he is entitled to draw Reserve retired pay and Civil Service retired pay simultaneously.

Is one drawing disability compensation entitled to Reserve retirement under the provisionsof Public Law 810?

No, says the Comptroller General.

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United States Stoneware Co., Akron, Ohio.

CHEMICAL RESERVES

(Continued from page 17)

charts, Army Regulations, procurement directives, drawings, and samples of Chemical Corps materials.

Reservists working on this exercise are aiming at the development of a highly specialized cadre of reserve procurement and supply specialists. Should an emergency arise, they will be available to transform procurement plans of the Chemical Corps into immediate action. This will be a significant contrast to conditions existing at the time of Pearl Harbor.

Even though some individual reserve officers experienced in chemical procurement could be found, no trained cadres of reservists, such as the 1021st ORASU is now developing, existed. Supply and procurement specialists were selected from civilian life on the basis of experience, commissioned, and following a preliminary two-week indoctrination course at Army Chemical Center (then Edgewood Arsenal), were assigned to chemical procurement districts throughout the nation. About three months were required for them to begin to show coordinated results in overall operations.

Actual procurement operations were often found deficient. They were based mainly on peacetime procedures and were completely inadequate to cope with the global commitments of the Chemical Corps. In addition, they were not always geared to modern warfare. For instance, horse gas masks were shipped to depots in Australia in the early days of the war under the usual procedure of allocating authorized items on standard TO & Es. By the time the gas masks arrived at their destination, the commitment of horse cavalry had been abandoned.

The possibility of a repetition of this sort of incident is rather remote. New weapons of modern warfare and new methods of waging a total war have brought about a degree of specialization which infused new life and energy into a hitherto dull routine military task. New missions of the Chemical Corps in the research and development fields among others, accelerated the formulation of postwar plans for future emergencies. Part of this planning was devoted to long-range training programs of which the present chemical procurement exercise is but the logical outgrowth. Chemical reservists are now well on the way towards fulfilling the goal of the ORC program for service type units. A future emergency will find the 1021st ORASU ready and capable of carrying out their assignments.

Similar training programs are being conducted by the 5409th ORASU of the Chicago Chemical Procurement District and by the 6220th ORASU of the San Francisco District. It is anticipated that similar programs may be put into operation at other chemical procurement districts throughout the nation.

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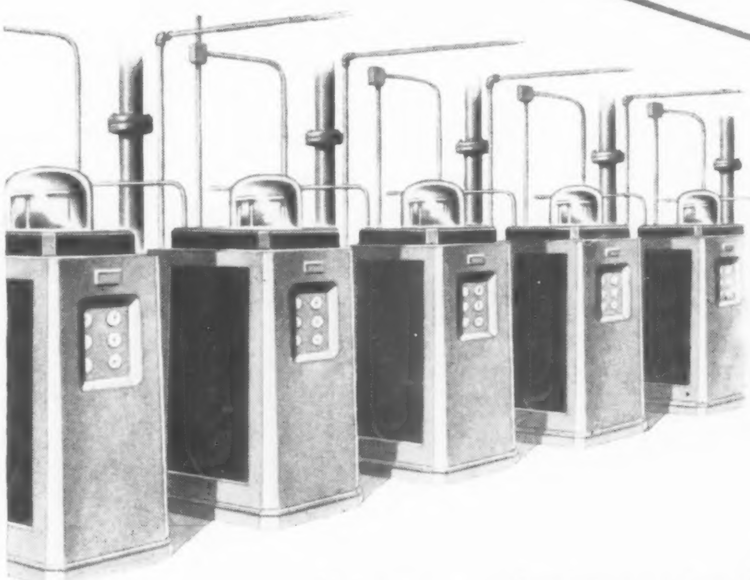

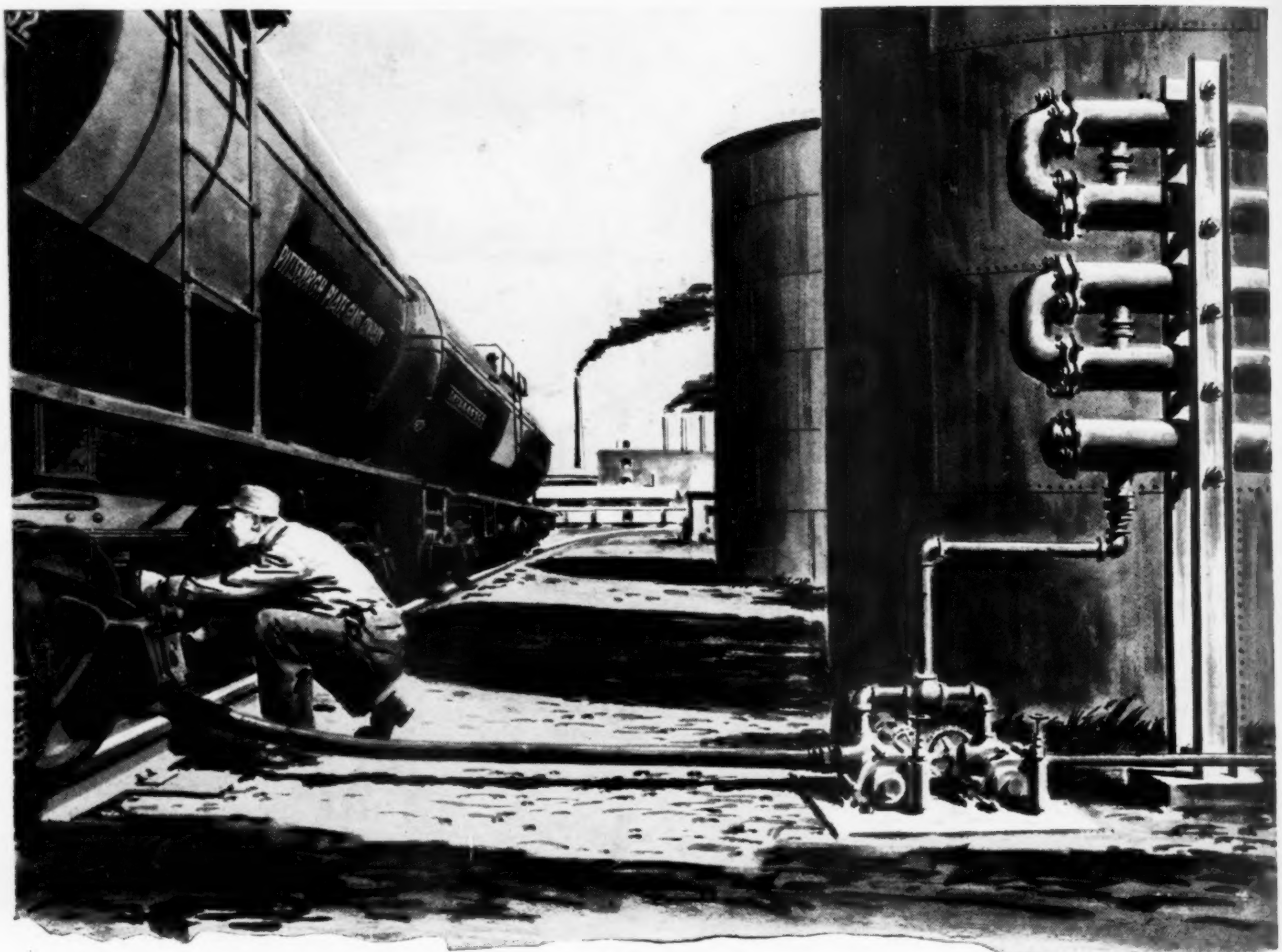

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